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March 24, 2017

Closing Date: Friday, April 7, 2017 at 6 p.m.

FROM: Vice President and Corporate Secretary

China - Reduction and Phase-out of PFOS in Priority Sectors Project

Project Appraisal Document

Attached is the Project Appraisal Document regarding a proposed trust fund grant from the Global Environment Facility (GEF) to China for a Reduction and Phase-out of PFOS in Priority Sectors Project (GEF/R2017-0007), which is being processed on an absence-of-objection basis.

Distribution:
Executive Directors and Alternates
President
Bank Group Senior Management
Vice Presidents, Bank, IFC and MIGA
Directors and Department Heads, Bank, IFC and MIGA

Document of
The World Bank

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Report No: PAD1742

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED GRANT FROM THE
GLOBAL ENVIRONMENT FACILITY TRUST FUND

IN THE AMOUNT OF US$24.25 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

REDUCTION AND PHASE-OUT OF PFOS IN PRIORITY SECTORS PROJECT

March 22, 2017

Environmental and Natural Resources Global Practice
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective November 1, 2016)

Currency Unit	=	Chinese Yuan (CNY)
CNY 6.78	=	US$1

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

AFFF	Aqueous Film Forming Foam
BAT/BEP	Best Available Techniques/Best Environmental Practices
CCFP	China Certification Center for Firefighting Products
CMS	Chromium Mist Suppressant
CNAO	China National Audit Office
CP	Cleaner Production
Cr	Chromium
DA	Designated Account
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ESMF	Environmental and Social Management Framework
EPB	Environmental Protection Bureau
EOR	Enhanced Oil Recovery
FECO	Foreign Economic Cooperation Office
FM	Financial Management
GEF	Global Environment Facility
GOC	Government of China
MEP	Ministry of Environmental Protection
MOF	Ministry of Finance
NATESC	National Agricultural Technology Extension Center
NCG	National Coordination Group for the Stockholm Convention in China
NIP	National Implementation Plan
OA	Operating Account
ODS	Ozone Depleting Substance
OP	Operational Policy
PBT	Persistent, Bioaccumulative, and Toxic
PCB	Polychlorinated biphenyls
PFC	Perfluorinated Compound
PFOS	Perfluorooctane sulfonate
PFOSF	Perfluorooctane sulfonyl fluoride
PMO	Project Management Office
POPs	Persistent Organic Pollutants

RAP	Resettlement Action Plan
RIFA	Red Imported Fire Ants
RPF	Resettlement Policy Framework
SA	Social Assessment
SOE	Statement of Expenditures
TDI	Tolerable Daily Intake

Regional Vice President:	Victoria Kwakwa, EAPVP
Country Director:	Bert Hofman, EACCF
Senior Global Practice Director:	Karin Kemper, GENDR
Practice Manager:	Iain Shuker, GEN2A
Task Team Leaders:	Laurent Granier, GCCFM/Solvita Klapare, GEN2A

CHINA
Reduction and Phase-out of PFOS in Priority Sectors Project

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PAD DATA SHEET

China

Reduction and Phaseout of PFOS in Priority Sectors (P152959)

PROJECT APPRAISAL DOCUMENT

EAST ASIA AND PACIFIC

Environmental and Natural Resources Global Practice

Report No.: PAD1742

Basic Information			
Project ID P152959	EA Category A - Full Assessment		Team Leader(s) Laurent Granier, Solvita Klapare
Lending Instrument Investment Project Financing	Fragile and/or Capacity Constraints [ ] Financial Intermediaries [ ] Series of Projects [ ]		
Project Implementation Start Date 7-April-2017	Project Implementation End Date 31-Dec-2022		
Expected Effectiveness Date 01-Sept-2017	Expected Closing Date 31-Mar-2023		
Joint IFC No			GEF Focal Area Persistent Organic Pollutants
Practice Manager/Manager Iain G. Shuker	Senior Global Practice Director Karin Kemper	Country Director Bert Hofman	Regional Vice President Victoria Kwakwa

Borrower: PEOPLE'S REPUBLIC OF CHINA					
Responsible Agency: Foreign Economic Cooperation Office of Ministry of Environment Protection					
Contact:	Yu Lifeng		Title:	Deputy Director General	
Telephone No.:	(86-10) 8226-8807		Email:	yu.lifeng@mepfeco.org.cn	

Project Financing Data (in USD Million)					
[ ]	Loan	[ ]	IDA Grant	[ ]	Guarantee
[ ]	Credit	[X]	Grant	[ ]	Other

Total Project Cost:	67.22	Total Bank Financing:	0.00
Financing Gap:	0.00		

Financing Source	Amount
Borrower	42.97
Global Environment Facility (GEF)	24.25
Total	67.22

Expected Disbursements (in USD Million)

Fiscal Year	2018	2019	2020	2021	2022	2023	0000	0000	0000	0000
Annual	1.50	4.00	5.50	7.50	4.50	1.25	0.00	0.00	0.00	0.00
Cumulative	1.50	5.50	11.00	18.50	23.00	24.25	0.00	0.00	0.00	0.00

Institutional Data

Practice Area (Lead)

Environment & Natural Resources

Contributing Practice Areas

Proposed Global Environmental Objective(s)

The project development objective is to reduce PFOS in selected sectors and enterprises in China in a sustainable manner.

Components

Component Name	Cost (USD Millions)
Component 1: PFOS Production Reduction	25.10
Component 2: Reduction of PFOS Use	12.59
Component 3: Policy and Technical Assistance	26.88
Component 4: Project Management	2.65

Systematic Operations Risk- Rating Tool (SORT)

Risk Category	Rating
1. Political and Governance	Moderate
2. Macroeconomic	Low
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	Moderate
5. Institutional Capacity for Implementation and Sustainability	Moderate
6. Fiduciary	Moderate
7. Environment and Social	Substantial
8. Stakeholders	Substantial

9. Other	
OVERALL	Substantial

Compliance

Policy

Does the project depart from the CAS in content or in other significant respects?	Yes [ ] No [X]
Does the project require any waivers of Bank policies?	Yes [ ] No [X]
Have these been approved by Bank management?	Yes [ ] No [ ]
Is approval for any policy waiver sought from the Board?	Yes [ ] No [X]
Does the project meet the Regional criteria for readiness for implementation?	Yes [X] No [ ]

Safeguard Policies Triggered by the Project	**Yes**	**No**
Environmental Assessment OP/BP 4.01	**X**	
Natural Habitats OP/BP 4.04		**X**
Forests OP/BP 4.36		**X**
Pest Management OP 4.09	**X**	
Physical Cultural Resources OP/BP 4.11		**X**
Indigenous Peoples OP/BP 4.10		**X**
Involuntary Resettlement OP/BP 4.12	**X**	
Safety of Dams OP/BP 4.37		**X**
Projects on International Waterways OP/BP 7.50		**X**
Projects in Disputed Areas OP/BP 7.60		**X**

Legal Covenants

Name	**Recurrent**	**Due Date**	**Frequency**
Implementation Arrangements	**X**		

Description of Covenant

Grant Agreement, Section I.A.1 of Schedule 2. The Recipient, through MEP, shall maintain the following entities with composition, powers, functions, staffing, facilities and other resources satisfactory to the Bank: (a) National Coordinating Group for Stockholm Convention Implementation; (b) Project Management Office.

Name	**Recurrent**	**Due Date**	**Frequency**
Implementation Arrangements	**X**		

Description of Covenant

Grant Agreement, Section I.A.2 of Schedule 2. The Recipient, through MEP, shall cause each project province to maintain the following entities with composition, powers, functions, staffing, facilities and other resources satisfactory to the Bank: (a) Steering Committee; (b) Provincial Project Management

Office responsible for implementation of the project at the provincial level.

Name	Recurrent	Due Date	Frequency
Project Implementation Manual (PIM)	X		

Description of Covenant

Grant Agreement, Section I.D.2 of Schedule 2. Throughout the project implementation, the Recipient, through MEP, shall apply the PIM in a timely and efficient manner satisfactory to the Bank. The Recipient, through MEP, shall not amend, suspend, or waive said PIM without the prior written agreement of the Bank.

Name	Recurrent	Due Date	Frequency
Annual Work Plan	X		

Description of Covenant

Grant Agreement, Section I.D.1 of Schedule 2. The Recipient, through MEP shall (a) prepare and furnish to the Bank by September 30 in each year, beginning in 2017, a draft Annual Work Plan; (b) taking into account the Bank's comments, finalize and furnish to the Bank no later than November 30 in each year, the Annual Work Plan; and (c) thereafter ensure the implementation of the project during the following calendar year in accordance with the Annual Work Plan.

Name	Recurrent	Due Date	Frequency
Sub-grants	X		

Description of Covenant

Grant Agreement, Section I.F.1 of Schedule 2. For the purposes of Parts 1 and 2 of the project, the Recipient, through MEP shall cause the project provinces to provide Sub-grants to Eligible Enterprises, within their respective jurisdictions in accordance with eligibility criteria and procedures acceptable to the World Bank and set out in the Project Implementation Manual.

Conditions

Source Of Fund	Name	Type
GEFU	Article IV, 4.01(a),(b)	Effectiveness

Description of Condition

The Grant Agreement shall not become effective until evidence satisfactory to the Bank has been furnished that: (a) the execution and delivery of the Grant Agreement on behalf of the Recipient has been duly authorized or ratified by all necessary governmental action; and (b) each Implementation Agreement has been executed on behalf of the Recipient, through MEP, and the respective Project Province.

Team Composition

Bank Staff

Name	Role	Title	Specialization	Unit
Laurent Granier	Team Leader (ADM Responsible)	Senior Environmental Specialist	Hazardous Waste Management	GCCFM
Solvita Klapare	Team Leader	Senior Environmental Economist	Environmental Economics	GEN2A

Guoping Yu	Procurement Specialist (ADM Responsible)	Senior Procurement Specialist	Procurement	GGO08
Fang Zhang	Financial Management Specialist	Sr. Financial Management Specialist	Financial Management	GGO20
Aristeidis I. Panou	Counsel	Counsel	Legal	LEGES
Chau-Ching Shen	Finance Officer	Sr. Finance Officer	Disbursements	WFALN
Zhuo Yu	Finance Officer	Finance Officer	Disbursements	WFALN
Erik Pedersen	Team Member	Consultant	Foam Sector Phaseout	GEN2A
Meixiang Zhou	Safeguards Specialist	Social Development Specialist	Social Safeguards	GSU02
Nina Queen Irving	Team Member	Senior Program Assistant	Operational Support	GEN2A
Viraj Vithoontien	Team Member	Lead Environment Specialist	Sector Phaseout Planning	GEN2B
Xieli Bai	Team Member	Program Assistant	Operational Support	EACCF
Xin Ren	Safeguards Specialist	Senior Environmental Specialist	Environmental Safeguards	GEN2A

Extended Team

Name	Title	Office Phone	Location

Locations

Country	First Administrative Division	Location	Planned	Actual	Comments
China	Hubei	Hubei		**X**	
China	Hainan	Hainan		**X**	
China	Guizhou	Guizhou		**X**	
China	Guangxi	Guangxi		**X**	
China	Guangdong	Guangdong		**X**	
China	Fujian	Fujian		**X**	

I. STRATEGIC CONTEXT

A. Country Context

1. China's chemical industry is experiencing considerable growth and projected to represent over 30 percent of global sales by 2030, estimated at over US$2.6 trillion. The country's production however is still dominated by low value added bulk chemicals with relatively weak management systems and capacity for environmentally sound disposal. The rapid increase of production and consumption in China since 1978 has brought about significant environmental pollution and ecological degradation. The Chinese Government is committed to reversing this negative trend and has made environmental protection a national priority. As part of this commitment, China ratified the Stockholm Convention on Persistent Organic Pollutants (POPs), a global treaty addressing a number of chemical substances (currently 26) listed as POPs, including perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF).

2. POPs are a group of chemical substances that persist in the environment, are transported far from their sources and bioaccumulate. Exposure to POPs can lead to serious health effects including cancer[1], birth defects, dysfunctional immune and reproductive systems, greater susceptibility to disease and damages to the central and peripheral nervous systems. The Convention was amended in 2009 to include, among others, PFOS which is subject to phase-out. This amendment entered into force for China on March 26, 2014 following approval of the National People's Congress in August 2013. The National Implementation Plan (NIP) for POPs first adopted in 2007 is being updated to take into account strategies and action plans for the new chemicals. Preliminary findings confirm that PFOS is the priority for China among the newly added POPs due to its production level and pervasive use of this chemical.

B. Sectoral and Institutional Context

3. *Environmental and Human Health Impact of PFOS*. PFOS was listed as a POP by the Stockholm Convention because it is bioaccumulative and toxic, and in particular because it is exceptionally resistant to degradation in the environment. Potential for long-range global transport has been demonstrated by monitoring data showing the presence of PFOS in environmental samples, in the Arctic, for example.

4. PFOS was measured in environmental monitoring samples in the Pearl River Delta, Haihe River and coastal areas of the Bohai Sea. The concentrations in these areas are of the same order of magnitude as those found in Europe's Po and Ruhr rivers[2], while high concentrations were recorded near areas where PFOS was produced and used, in water and sediments of lake Tangxun in Wuhan, and in sediments of the Yangtze estuary. High levels of PFOS have also been recorded in the rain in Dalian and Shenyang, and in sewage sludge in Guangzhou[3]. Concentrations in blood in the general population are comparable to levels in the

[1] According to US EPA Science Advisory Board what is known of cancer data for PFOS fit EPA's guidelines for "likely to be carcinogenic to humans".
[2] China's water pollution by POPs, Bao et al, Environ. Pollut., 2012
[3] *PFOS phase-out plan in Chinese priority industries*, background report for the preparation of the project, Tsinghua University and Shenyang Academy of Environmental Sciences, 2016

US or Japan[4], albeit on the high side[5]. Whilst some studies have found gender-related differences with PFOS levels in blood, many did not and explanations remain inconclusive, with higher levels in males likely resulting from greater occupational exposure. Overall, the picture based on limited available information is of apparently moderate risk on a country-wide scale, but with localized environmental and health risks near areas of production and use[6].

5. *PFOS control.* The Stockholm Convention defines seven acceptable purposes and six specific exemptions that have been registered with the Secretariat of the Convention by the Chinese Government. Use for acceptable purpose is allowed under the Convention, while exemptions expire in 2019. China has banned all other uses that are not listed as exempted or acceptable. The acceptable purposes are: (a) photo-imaging; (b) photo-resist and anti-reflective coatings for semi-conductors; (c) etching agent for compound semi-conductors and ceramic filters; (d) aviation hydraulic fluids; (e) metal plating (hard metal plating) in closed-loop systems only; (f) certain medical devices; and (g) firefighting foam. The specific exemptions are: (a) photo masks in the semiconductor and liquid crystal display (LCD) industries; (b) hard metal plating; (c) decorative metal plating; (d) electric and electronic parts for some color printers and color copy machines; (e) insecticides for control of red imported fire ants and termites; and (f) chemically-driven oil production.

6. *PFOS production and use.* China started manufacturing PFOS from the late 1980's with a cumulative production of 1,600 metric tons to date, and is the only known remaining producer worldwide. There are 12 producers in China that have or had capacity to manufacture PFOSF. In 2015, only four producers were still manufacturing a little over 100 metric tons of PFOSF annually and supplying it to other downstream producers (approx. 20) to produce PFOS-related substances that in the end translate to at least 100,000 metric tons of PFOS containing products and materials. All PFOSF production lines employ the same industrial process.

7. The main remaining four applications in the country as confirmed both by the NIP update effort underway and a study undertaken for project preparation are: chromium mist suppressant in the electroplating industry (CMS – approx. 17 tons/an); surfactant in foam formulations for firefighting (AFFF – approx. 61 tons/an); sulfluramid formulations for pest control (approx. 1 ton/an); and in chemically-driven enhanced oil recovery in oil production (EOR – approx. 26 tons/an). Geographically, use is concentrated in the Eastern provinces for metal plating and firefighting, where industrial activity is most prominent, and in the Southern provinces for pest control where the infestation from red imported fire ants started and is still the strongest.

8. *Approach to PFOS phase-out.* Of the POPs newly listed under the Stockholm Convention in 2009, China prioritizes the reduction and control of production and use of PFOS because of the large number of existing applications, and the relatively poorly understood status of alternatives. PFOS products are transformed and reformulated at a number of progressively more downstream producers and users where their PFOS nature may not even be recognized. A

[4] The inventory of sources, environmental releases and risk assessment for perfluorooctane sulfonate in China, Zhang et al, Environ. Pollut., 2012

[5] Perfluorooctanesulfonate and related fluorochemicals in human blood samples from China, Yeung et al, Environ. Sci. Technol., 2006

[6] *PFOS phase-out plan in Chinese priority industries*, Op. Cit.

large number of enterprises in the metal plating sector are driven primarily by the quality of the final products while environmental management is still a distant consideration. Moreover, the longer-term objective of PFOS reduction in the global environment could be seen as conflicting with the immediate objective of worker's safety given that PFOS-based chromium mist suppressant was introduced to limit workers' exposure to chromium during the metal plating process. In the pest management domain, many of the alternative pest control chemicals also come with their own hazards and toxicity to non-targeted organisms. For the firefighting foam sector, public safety is the utmost priority of the Ministry of Public Security. Hence, a PFOS reduction strategy and action plan must offer not only environmentally sound alternatives but also alternatives that would not compromise other objectives of the industries and sectors concerned.

C. Higher Level Objectives to which the Project Contributes

9. The proposed project will contribute to China's compliance with the Stockholm Convention on elimination of POPs. The project not only contributes to the protection of the global environment from the long-range transport and effect of PFOS, but also contributes to protection of human health, both globally and locally. The project also contributes to strengthening the capacity of the country for the sound management of chemicals more broadly beyond its PFOS-specific reduction objective, including to address the broader range of perfluorinated chemicals recognized as emerging contaminants of concern by the international community.

10. The project also responds to the objectives of the China's 13th Five Year Plan, which emphasizes a cleaner and greener economy, with a strong commitment to environmental management and protection, clean energy and emissions controls, ecological protection and security and the development of green industries. It will particularly support the Government of China's priority initiatives of enhanced hazardous waste pollution prevention and control, elimination of outdated industrial equipment and processes, and improved monitoring of industrial pollution sources.

11. The proposed project is consistent with Strategic Theme One: "Supporting Greener Growth" of the China – World Bank Group's Country Partnership Strategy for FY 2013-2016 (Report 67566-CN), discussed by the Bank's Board of Executive Directors on November 6, 2012. Under this theme, the project would support Outcome 1.6: Demonstrating Pollution Management Measures, which would be achieved among others by "supporting efforts to reduce hazardous waste, by continuing to support the reduction of POPs - the by-products of industrial production and the world's most toxic chemicals - from the regulatory level to emissions control and urban site clean-up." The project will also contribute to the World Bank Group's goals of ending extreme poverty by 2030 and boosting shared prosperity through improving health conditions by reduced exposure to pollution and increased access to reliable and accurate environmental information. Access to information is currently limited for the bottom 40 percent, who are known to be relatively more exposed to degraded or highly-polluted areas than other population groups.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

12. The project development objective is to reduce PFOS in selected sectors and enterprises in China in a sustainable manner.

B. Project Beneficiaries

13. The main project beneficiaries include manufacturers producing PFOSF and PFOS and users of these chemicals in the metal plating industry, pest management sector, firefighting foam industry, state and local government agencies, research institutes, and industry associations, in China. Direct beneficiaries, including proportion of women, are assumed to include the number of workers in enterprises with PFOSF production in 2015; people living in the counties where these production facilities are located; workers in metal plating demonstration enterprises; workers in participating foam manufacturers; and people previously spraying sulfluramid in project demonstration areas.

C. PDO Level Results Indicators

14. The PDO level results indicators include: (a) amount of PFOS produced and used yearly reduced by 44 tons – as there is no longer export or import of PFOS or PFOSF, the amount of PFOSF produced and PFOS used are equivalent; (b) control and monitoring system for tracking PFOSF production and sale established and operational; and (c) number of direct project beneficiaries including female beneficiaries (core sector indicator).

III. PROJECT DESCRIPTION

A. Project Components

15. The project will consist of three components and project management component: the first component addresses PFOS/PFOSF production reduction; the second component addresses PFOS use and release reduction in chromium mist suppressant for metal plating, in pesticide formulations for invasive pest control, and for PFOS-based firefighting foam; and the third, technical assistance, component will support capacity building and policy development to ensure sustainable phase-out of PFOS in the targeted sectors. Policy development activities will be extended to cover PFOS reduction in the enhanced oil recovery application.

16. As beneficiaries of the project are located in several provinces throughout China, the project includes a project management component which will finance operations of two provincial project management offices located in the provinces with high density of PFOS production and consumption. Other provinces will be covered by the project management office established within FECO.

Component 1: PFOS Production Reduction (total cost US$25.1 million of which GEF US$5.1 million; Recipient cofinancing US$20 million)

17. The project will support production phase-out and reduction for primary PFOSF producers and at secondary PFOS producers (approximately 14 companies). Activities to be financed include: closure; conversion of production to non-POPs like chemicals; and adoption of best environmental practices at facilities that will continue production of PFOS and PFOSF for acceptable uses under the Stockholm Convention.

18. *Conversion of production facilities*: This component will finance conversion of PFOSF production facilities and offer incentives to support downstream PFOS manufacturers in switching to new non PFOS-based products. The project would not finance any production of chemicals known to possess persistence, bio-accumulative and toxic (PBT) characteristics. Eligible incremental expenditures would include: (a) development of non-PFOS products; (b) costs related to registration of new products; (c) equipment and technology transfer costs; (d) installation of equipment; (e) training; (f) trial production; (g) incremental costs of new raw materials, utilities, waste management; and (h) costs of disposal of contaminated equipment previously used for producing or storing PFOS.

19. *Plant or production line closure*: GEF incremental support would be extended to enterprises that might decide to close down their production facility altogether. GEF resources will be used to support management of environmental liabilities from such closure. Eligible incremental expenditure would include: (a) dismantling costs; (b) disposal costs of contaminated equipment and materials; and (c) consulting services to develop site risk assessment, management and monitoring plans. Remediation beyond disposal of contaminated equipment will be financed by other sources outside of the project.

20. *Promotion of cleaner production*: In line with BAT/BEP requirements under the Stockholm Convention, the project would promote introduction of cleaner production (CP) techniques and practices so as to limit the risks of environmental releases or to worker's health and safety resulting from PFOS production. Eligible expenditures include: (a) consulting services to develop CP audits; (b) overseeing implementation of CP measures; (c) technology upgrading; and (d) training. The project would also promote phase-out at downstream producers through support to a "MEP PFOS stewardship program", including strengthening of label specification.

Component 2: Reduction of PFOS Use (total cost US$12.59 million of which GEF US$8.12 million; Recipient cofinancing US$4.47 million)

21. Three priority sectors are addressed in this component: chromium mist suppressants in the metal plating sector, firefighting foam sector, and pesticides for control of red imported fire ant (RIFA). The fourth large sector in terms of consumption, oil production, is addressed through TA only under component 3.

22. *Chromium mist suppressant in metal plating*: The project will finance demonstration activities to showcase non-PFOS alternatives and closed-loop systems, with equivalent or

improved efficacy in terms of protection of human health and safety. The demonstration activities include installations of approx. two closed-loop systems for different chrome-plated product lines and introduction of non-PFOS alternatives in at least 20 companies using chromium mist suppressant for manufacturing various products in up to three industrial parks. The industrial parks will be selected during the project implementation. Criteria for selection of these industrial parks would include the number of chrome plating enterprises, environmental management capacity of the industrial parks, and willingness to showcase demonstration activities to similar industry in other industrial parks.

23. The project will finance costs in relation to acquiring of the following: (a) upgrade of facilities to closed-loop systems; (b) chrome plating baths replacement; (c) new chromium mist suppressant; (d) other equipment, testing device, and control systems related to the use of new alternatives; (e) ventilation and safety equipment; (f) site preparation for installation of new equipment; (g) replacing Cr(VI) with Cr(III) which will eliminate the use of chromium mist suppressant altogether; and (h) advanced treatment facilities for up to three industrial parks for removing perfluorinated compounds (PFCs) from water discharge from chrome plating industry.

24. *Firefighting foam*: The project will finance development and production of non-PFOS firefighting foam at 3-5 firefighting foam manufacturers. The selection criteria of firefighting foam manufacturers would include: (a) research and development capacity; (b) relevant experience with firefighting chemicals; (c) large network of firefighting foam clients; (d) good environmental performance record; (e) in-house capacity to develop non-PFOS surfactants or technical cooperation with reputable surfactant manufacturers; and (f) cost effective proposals.

25. The following costs will be covered by the project: (a) research and development of new non-PFOS based firefighting foam; (b) environmental and health impact evaluation of new alternatives; (c) new equipment for manufacturing non-PFOS based firefighting foam; (d) site preparation for installing new equipment; (e) tanks and storage facilities; (f) testing efficacy of new products; and (g) registration of new surfactants and firefighting foam. In addition, financing costs of new non-PFOS firefighting foam needed for training at 3 training facilities of the public security ministry could be supported, as well as costs of firefighting equipment retrofit or procurement of new equipment, together with facilities for treatment of wastewater discharge.

26. *Pest control*: The project will finance procurement of pesticides (9 tons total: 6 tons of indoxacarb based baits, 3 tons of cypermethrin based powder, and a small amount of hydramethylnon) for demonstration of a two-phase treatment method using bait and powder to control red fire ants, carried out under component 3.

Component 3: Policy and Technical Assistance (total cost US$26.88 million of which GEF US$9.88 million; Recipient cofinancing US$17 million)

27. This component will finance technical assistance activities required to strengthen regulatory and policy framework, standards, and capacity building. These activities are essential for ensuring sustainability of PFOS phase-out in both production and consumption sectors. TA activities include:

28. *Standards and Regulations*: The project will carry out activities to develop industry standards, good practices, and regulations to support introduction of non-PFOS alternatives. Supported activities would include: (a) labelling scheme to ensure that commercially available chromium mist suppressant will have to be properly labelled; (b) development of technical specifications for chromium mist suppressants, including efficacy in protecting human health and safety; (c) standards defining PFOS waste, and related best practices for disposal; specification of discharge of wastewater containing PFOS for electroplating industry in Guangdong province; (d) development of guidelines for cleaner production for organofluorine manufacturing industry; (e) revision of cleaner production audit indicator system for electroplating industry to include PFOS in Guangdong Province; (f) technical report on efficacy of non-PFOS based pesticides for controlling red imported fire ant; and (g) development of guidelines for use of safer alternatives for the oil sector.

29. *Screening of non-PFOS alternatives*: To ascertain that new non-PFOS alternatives to be introduced in China should not have PBT characteristics, a PBT screening system for new chemicals will be established. Supported activities include: (a) guidelines for registration of new chemicals including reporting requirement on PBT characteristics; (b) development of standard testing protocol for determining PBT characteristic of organofluorine chemicals; and (c) screening reports on PBT characteristics of at least 10 non-PFOS chromium mist suppressants.

30. *Technical studies*: A series of studies will be carried out under the project to enhance understanding of import/export control of PFOS, and of PFOS use as CMS in electroplating factories in Guangdong province. To guide the chrome plating industry in the future as part of the efforts to sustain achievement of this project, the project will finance the testing of mist suppression performance of alternatives and develop a list of acceptable chromium mist suppressants. A preliminary study will also be conducted on health impacts of PFOS in China as a first step to scoping and better understanding the issue.

31. *Technical Assistance to reduce the use of PFOS in firefighting*: The project will support testing the safety and efficacy of alternative non-PFOS firefighting foams and products; devising technical way forward for substitution of PFOS in the firefighting sector; revising relevant standards as needed; capacity development to detect PFOS substances in foam extinguishing agents; and strengthening the tracking and control of PFOS containing firefighting agents. Since a large quantity of PFOS firefighting foam is used for training, adopting new non-PFOS alternative foam could lead to permanent reduction of a significant quantity of PFOS. The project would therefore finance revision of firefighting protocols and training manuals for effective use of new non-PFOS firefighting foam without compromising safety and health of firefighting cadets.

32. *Technical Assistance to eliminate the use of PFOS for control of RIFA*: Demonstration of alternative pest management techniques and practices will be conducted for four years in 5 provinces, Fujian, Guangdong, Guangxi, Guizhou and Hainan. The project will cover costs related to the 'training of trainers' program in the 5 demonstration provinces and up to additional 5 provinces. Participants will include county, municipal and provincial level practitioners.

33. *PFOS registration and reporting system*: The project will strengthen capacity of Ministry of Environment Protection (MEP) and local Environmental Protection Bureaus (EPBs) to enforce regulations and monitoring requirements for hazardous substances. A tracking system will be developed to support registration of producers of PFOSF, secondary PFOS based product manufacturers, and users of PFOS products in firefighting foam industry. The system will assist China to monitor production and supply of PFOS materials from sources to end users. Technical capacity of local EPBs will be strengthened to enable them to carry out or supervise factory audits to prevent any diversion of PFOSF to banned applications. Efforts would mainly focus on strengthening capacity of local EPBs in Fujian and Hubei to control the PFOS supply chain.

Component 4: Project Management (total cost US$2.65 million of which GEF US$1.15 million; cofinancing US$1.5 million)

34. Component 4 will finance: (a) costs of operations of three project management offices (PMOs) at FECO, Guangdong EPB and Hubei EPB, as well as (b) Monitoring and Evaluation. Eligible costs include expenditures incurred by the PMOs in carrying out the project, printing, communication, office equipment and supplies, service contracts for office equipment and utilities, and public awareness materials.

B. Project Financing

35. The project and sector phase-out will be supported through GEF grant (36 percent) and direct cofinancing estimated at US$42.97 million (64 percent), including in-kind funding from the national and local governments and from the beneficiary enterprises. In addition, the cost of sector-wide compliance with the Stockholm Convention for exempted applications targeted by the project is estimated to represent an additional contribution of US$110.03 million – at least – from industry and represents cofinancing from a GEF perspective.

Project Cost

36. The table below summarizing the project cost and financing by component.

Project Component	Project Cost (US$)	GEF (US$)	Cofinancing (US$)	GEF % Financing
Component 1: PFOS Production Reduction	25,100,000	5,100,000	20,000,000	20
Component 2: Reduction of PFOS Use	12,590,000	8,120,000	4,470,000	65
Component 3: Policy and Technical Assistance	26,880,000	9,880,000	17,000,000	37
Component 4: Project Management	2,650,000	1,150,000	1,500,000	43
Total	67,220,000	24,250,000	42,970,000	36

C. Lessons Learned and Reflected in the Project Design

37. PFOS products are consumed by a large number of enterprises - 3,000 to 4,000 users located throughout China, with PFOS products supplied by local manufacturers. To achieve phase-out of PFOS in the priority sectors, the project would have to phase out the supply and demand of PFOS simultaneously. Since not all PFOS production nor applications are or will be banned in 2019, efforts must be made to ensure no diversion of PFOS products to unintended applications.

38. The Bank has extensive experience in supporting projects with features similar to this project. Previous projects included several sector plans for phasing out ozone depleting substances (ODS) in India, China, and other countries in East Asia and Latin America where interventions covered reduction of production or closure of production facilities combined with conversion of manufacturing processes at enterprise-level. As production and consumption of these chemicals are still allowed for certain applications by the international community, control and monitoring systems were established and are still in operations today in order to preempt diversions of these chemicals for banned applications.

39. These experiences and lessons learned are very relevant to this project and have been incorporated in its design. In particular, the reporting requirements for chemical producers and verifications of production and distribution of targeted chemicals adopted in the previous projects offer a useful model. Combination of investment interventions in larger enterprises, demonstration projects, and dissemination of experience from larger to smaller enterprises along with timely implementation of policy and regulations will be employed to ensure complete phase-out in the targeted applications in a timely manner.

40. As the project would entail closure of existing PFOS production and manufacturing sites, experiences from the previous ODS projects, and two previous POPs demonstration projects supported by the Bank and funded by GEF were taken into account. These involved: (a) cleanup of chlordane and mirex production sites and a number of PCB contaminated sites; (b) use of existing guidelines for proper dismantling of production facilities; site investigation; and development of site remediation plans; and (c) approaches to estimating economic benefits.

41. Finally, careful consideration of the right incentives to ensure enterprise participation is key, as proven by a number of projects, including the ongoing China Dioxins Reduction from the Pulp and Paper Industry project. Such incentives will be designed in conjunction with effective public and industry awareness-raising activities, which the project will pay special attention to.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

42. The Foreign Economic Cooperation Office (FECO) under the MEP will serve as the overall national implementing agency for the project which will be implemented by three PMOs - one housed in FECO, one in Guangdong and one in Hubei Environmental Protection Bureaus (EPBs). FECO PMO will implement national level activities and supervise and support project implementation by the two PMOs and consolidate project progress and financial reports. FECO

PMO will implement other activities outside of Guangdong and Hubei provinces, in particular in Fujian, Hainan, Guizhou, and Guangxi, with technical experts dispatched to the four provinces to guide project implementation. An Implementation Agreement would be signed between FECO as the national implementing agency and the two PMOs to set out responsibilities of the parties, the GEF grant amount to be allocated to the activities managed by the respective PMO and counterpart funding (including in-kind contributions).

43. To ensure strong stakeholder involvement, the existing inter-ministerial National Coordination Group (NCG) for implementation of the Stockholm Convention will continue to provide overall guidance and coordination for implementation of the project and to facilitate adoption of national level regulations as early as possible. The NCG includes 14 ministries with MEP as the Lead Agency. FECO will organize NCG meetings at least once a year to report and collect feedback/comments on project implementation. In addition, the currently established convention implementation offices in Guangdong and Hubei provinces will serve as Steering Committees to guide project implementation in these provinces. The Steering Committees will ensure that other local government, academia and private sector stakeholders are invited to contribute in their respective areas of competence, as well as ensure information sharing with these agencies on a regular basis.

B. Results Monitoring and Evaluation

44. The strategy for assisting China to reduce and eliminate the use of PFOS in priority sectors will focus on control and monitoring the supply chain of PFOSF, which is the primary material used for producing secondary materials for various applications. A tracking system will be developed to support registration of producers of PFOSF, secondary PFOS based product manufacturers, and users of PFOS products in firefighting foam industry. The system will assist China to monitor production and supply of PFOS materials from sources to end users, and will form a basis to monitor overall project results and achievements in a sustainable manner.

45. Progress towards PDO will be monitored through the outcome indicators included in the Project Results Framework in Annex 1, using data collected by FECO and the two provincial PMOs. The project's monitoring and evaluation plan includes: annual work plans and budgets; periodic on-site inspection and verification by FECO and PMO staff; consolidated semi-annual project progress reports compiled by FECO and submitted to the World Bank; consolidated semi-annual unaudited Interim Financial Reports on use of funds; completion reports for all demonstration sub-projects under components 1 and 2 and firefighting and pest control technical assistance activities; consolidated project completion report from FECO; annual financial audits of the project account with FECO; and yearly reports to the GEF including mid-term and final GEF tracking tool.

C. Sustainability

46. The proposed project offers an overall strategy for assisting China to reduce and eliminate the use of PFOS in priority sectors in a sustainable manner. To ensure sustainable reduction of PFOSF and preempt future diversion of PFOSF to banned applications after 2019, the project will establish a monitoring system to track the flow of PFOSF to downstream industry. Given that the use of PFOS in pesticide control, oil extraction, and chrome plating industry will not be allowed after 2019, the monitoring system will impose a production audit on

the remaining PFOSF producer to ensure that PFOSF produced by this facility will only be made available for acceptable use. Downstream users of PFOS that further manufacture PFOS-based products, such as surfactant companies for firefighting foam, will have to be registered and will also be subject to the proposed audit, and will be required to report the amount of PFOSF purchased and the amount of PFOS based products sold to their respective clients. Through this audit requirement, it will be assured that PFOSF produced after 2019 will not be diverted to unintended applications, ensuring sustainability of the project's impact.

47. To eliminate demand of PFOS based products, the project will finance several activities to develop and demonstrate effective use of non-PFOS based alternatives in the downstream industry, including metal plating industry, firefighting applications, and pesticide control. These downstream applications cover approximately 75 percent of the total PFOSF demand in China. The oil industry which is responsible for another 25 percent of consumption has indicated to MEP that the industry would phase out use of PFOS products by 2019 in line with Stockholm Convention requirement. In addition, the project will finance development of policy, regulations, standards, cleaner production index, and best practices, to ensure proper screening of new alternatives and that the use of these new alternatives would not lead to other adverse environmental and health impacts.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

48. Based on the assessment of the main risks identified during project preparation, the overall risk is rated as "Substantial". The key risks and mitigation measures have been identified. The two main (Substantial) risks to the successful achievement of the project objectives or potentially causing unintended results are: (a) unintended environmental impacts that may relate to toxicity and other environmental impacts of alternatives; and (b) stakeholder risk given the focus on sectors that involve large amount of enterprises of various sizes, characteristics and cofinancing capacities.

49. Risk related to the toxicity and potential environmental impacts of PFOS alternatives – some of the known alternatives to PFOS (e.g., F-53B) are suspected of eliciting the same POPs-like characteristics as PFOS. This risk will be mitigated through strong emphasis on screening of potential alternatives for POPs characteristics, as well as strengthening capacities for such screening.

50. There is a substantial stakeholder risk due to large and diverse applications of PFOS and large number of enterprises involved. This risk will be mitigated by setting up clear demonstration enterprise selection criteria, including analysis of their financial capacity, as well as working with industry associations and pilot province environmental / sector authorities for delivery of assistance. Some future project enterprises that partially or entirely close their PFOS production, may potentially require job changes or losses of a small number of workers. To address this risk, measures proposed in the employee resettlement plan framework, which is part of the ESMF, will be followed during project implementation. While setting up three PMOs to support project implementation will also be one of the stakeholder risk mitigation measures, providing a sufficient hands-on training to the newly recruited PMO staff by the Bank team will

be needed. One PMO – in FECO – has extensive Bank-financed project implementation experience, while the PMOs in two provinces - Guangdong and Hubei - will require more support from the Bank team.

51. Finally, there is a moderate technical design risk related to the availability and acceptability of alternatives by industry, given that the project will introduce PFOS alternatives that are largely new in China, and that industry has concerns as to their efficacy and cost effectiveness. This is particularly true for the firefighting foam production sector which is an acceptable application beyond 2019. This risk will be mitigated through activities to support design and screening of PFOS alternatives, introducing incentives for demonstration enterprises, and extensive communication strategy. It should also be noted that, while not in widespread use in China, surveys and field visits conducted in preparation of the project confirm that some alternatives to PFOS do exist on the market in China today for many applications. Moreover, the project will support the development of a strong monitoring system to be implemented by FECO and relevant regulatory authorities to ensure that PFOS is produced and used for acceptable uses only.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

Economic analysis

52. PFOS is ubiquitous and toxic. Reduction of its production and use will lead to reduced occupational exposure and releases to the environment, and therefore reduced risks of harmful effects on human health and the environment. Estimates prepared at project preparation show that converting to non-PFOS alternatives in production, firefighting, metal plating and pesticide sectors would cost China well over US$270 million. The GEF funds will be spent to spearhead the substitution of alternatives and demonstrate BAT/BEP with due attention paid to capacity building activities, while the private/industrial sector and government will bear most of the incremental costs. The project seeks to limit costs to PFOS reduction by introducing and promoting locally available alternatives where possible and locally appropriate best practices. The project will also support the development of regulation covering the different stages of the life-cycle of PFOS, and support regulatory enforcement.

53. Project implementation would help reduce exposure to PFOS of at least 7.2 million people currently living and working in the PFOSF production areas or engaged in spraying PFOS-based pesticides for RIFA control (and over 1600 employees of participating enterprises), improving food safety and quality and their overall living environment. More people will directly benefit from activities that will reduce PFOS use in various industrial applications that will be selected during project implementation. Monetizing direct impacts on human health from PFOS exposure is a complex task that would require extensive research and epidemiological evidence unavailable at this point.

54. Additional benefits of the project include the saved costs of remediation of areas exposed to PFOS, particularly through introducing non-PFOS alternatives in the firefighting sector and through avoidance of PFOS containing waste disposal in landfills. These costs avoided by

phasing out PFOS through the project provide one estimate of benefits. For example, a large amount of PFOS-based firefighting foam is used for training purposes. Assuming that just 20 percent of the foam is being used for training or fire extinguishing purposes in China, the remediation cost of the land exposed to PFOS could cost over US$800 million (for details see Annex 5). This would easily offset the cost of conversion of the entire sector. Similarly, while no assessment of PFOS disposal has been carried out in China, remediation following unsound PFOS disposal practices, based on worldwide experiences, has proven to be costly. For example, the estimated remediation costs of four PFOS contaminated landfill sites in Minnesota, USA, range between US$12.6-27.6 million.

55. The project's investment in conversion of production and promotion of alternatives will follow a least cost approach, based on strict control at the source of PFOS being produced and available to the market only for allowed use under the Stockholm Convention and Chinese regulations, with incentives to industry to facilitate buy-in and implementation of PFOS phase-out, as an effective way to achieve the Government's policy objective and meeting international treaty commitments.

Financial analysis

56. Change to production and use of non-PFOS chemicals will involve investment in technology, research and development, facility reconstruction, equipment purchase etc. A financial cost-benefit analysis and estimated investment payback period has been carried out to illustrate the financial impacts of the project, taking as example Hubei Hengxin Chemical Industry Co., Ltd., one of the PFOSF producers that has expressed strong interest in seeking project support for conversion of their production to non-PFOS alternatives (for details see Annex 5). The cost-benefit analysis shows that by introducing non-PFOS alternatives in production and assuming 100 percent design capacity, Hubei Hengxin Chemical Industry Co., Ltd. annual average profit would reach RMB 18 million with investment payback period of 8.3 years.

57. Based on the data from the financial cost-benefit analysis of Hubei Hengxin Chemical Industry Co., Ltd., the preliminary analysis of net benefit stream has also been carried out for the remaining six active PFOSF manufacturers and is summarized in Annex 5. The analysis shows that the aggregated investment of RMB 176.14 million in seven PFOSF manufacturing enterprises would generate RMB 266.37 million sales revenue and an annual average profit after tax of approx. RMB 26.17 million. Average investment payback period would be 6.7 years, without funding from GEF grant. With GEF Grant, the payback period is estimated to reach 4.3 years. Thus, it can be concluded that the profitability of PFOS manufacturers before product change would be roughly equal to that of PFOS manufacturers after product change. However, product change would positively influence the operation of those manufacturers within 4-5 years.

B. Technical

58. Component 1 addresses PFOSF and PFOS producers. In instances of converting existing facilities to produce non-PFOS alternatives, only alternatives that do not have PBT characteristics would be financed by the project. In addition, the alternatives must meet existing regulations and standards in China. Proper tests and certification of new alternatives must be

part of the conversion activities financed by the project. For best environmental practices, proposed activities must meet at a minimum the requirement of the BAT/BEP guidelines for exempted and acceptable applications developed by component 3 of the project.

59. Component 2 addresses PFOS reduction in the following applications: chromium mist suppressant in metal plating; pest control; and surfactant in firefighting foam formulation.

(a) Chromium mist suppressant in metal plating – Trivalent chromium Cr (III) is a preferred alternative for decorative chrome plating where plating thickness requirement is lesser. Cr (III) is less toxic and therefore chrome mist suppressant (CMS) is not required. This alternative technology is a fairly common practice in some countries, however it is not yet well known or accepted by the industry in China which is concerned with product quality. For hard chrome plating where the use of Cr (III) is still at the research and development stage, a number of chemical alternatives can also be found in the market, although they are not widely used at present in China. Another option that would be financed by the project is the closed-loop system which would be financially viable for the largest companies. The project will also confirm suspected PBT characteristics of F-53B, the alternative developed in China, and whether it should be controlled.

(b) Pest control – Over the past 10 years, formulations have been developed and evaluated for indoor and field prevention and control of red imported fire ants. A number of possible alternatives that show the strongest efficacy in controlling red imported fire ants have considerable negative impact and toxicity towards non-targeted organisms. For these reasons, the project will consider indoxacarb-based insecticide as the option in the near term due to its moderately toxic to non-targeted organisms. The project will also support testing and development of other potential candidates and application technologies to increase the range of control options available in the future.

(c) Surfactant in firefighting foam formulation – While there is an on-going worldwide shift away from using PFOS-based surfactants in Aqueous Film Forming Foams (AFFF), these are used for sensitive applications such as to put away industrial fires, and in airports, military bases and oil terminals, for example. Therefore, the bar for acceptance and registration of alternatives is set understandably high by the responsible authorities. Input from industry stakeholders and regulators during project preparation however suggests that suitable alternatives can be developed in China.

C. Financial Management

60. The project will be implemented by the three PMOs located at FECO, Guangdong EPB and Hubei EPB. FECO PMO will be responsible for the overall project monitoring, management and coordination. One Designated Account (DA) will be opened and maintained at FECO. Further advances from the DA will be made into two segregated Operating Accounts (OAs) maintained by Guangdong and Hubei EPBs. A FM capacity assessment of all concerned implementing agencies identified that FECO has extensive experience with Bank operations but the two provincial PMOs' lack of knowledge and experience in managing Bank financed projects is a principal FM risk. In addition, performance-based sub-grant will be arranged against the demonstration activities implemented through selected beneficiaries as described in Annex 3,

which may bring an additional FM risk. To address these principal risks, the following risk management measures have been agreed: (a) preparation and issuance of a Financial Management Manual, including sub-grant implementing arrangements as part of the Project Implementation Manual, acceptable to the Bank, to standardize project FM procedures; (b) in addition to extensive FM training from the Bank, FECO who has extensive experience with the Bank operations will arrange more workshops and experience sharing events for local agencies; (c) FECO as the central PMO shall carry out semi-annual FM supervision to the subprojects implemented by provincial agencies especially during the initial one or two implementing year(s).

61. With implementation of the proposed actions, the FM arrangements will satisfy the World Bank's requirements under OP/BP 10.00. See Annex 3 for additional information.

D. Procurement

62. The Bank's procurement capacity assessment confirmed that the three PMOs housed in FECO, Hubei and Guangdong have sufficient capacity to manage procurement activities under this project and the risk rating is Moderate. FECO prepared a Procurement Plan for all project activities dated January 25, 2017, which has been reviewed and agreed by the Bank. Based on actual implementation progress, this Procurement Plan will be updated and disclosed annually or as required, subject to the Bank's prior review.

E. Social (including Safeguards)

63. The project has been assigned a category A for safeguards purposes, given the highly complex environmental impacts and potentially significant risks involved. The project focuses on demonstration, replacement, reduction and phase-out in enterprises in the PFOS production, metal plating, pest control and firefighting sectors. The project will support closure of redundant facilities, including support for site management and monitoring plans associated with previous production of PFOSF. The project is expected to have positive social benefits as it will reduce the negative health impacts associated with PFOS production by producing non-PFOS alternatives. By project appraisal, one pilot enterprise was under consideration, i.e., Hubei Hengxin Chemical Company Limited (HHCC), although its participation and details of investment plans have not yet been confirmed. According to social assessment, this company was established in 2004 occupying less than two hectares in Yingcheng City. It is currently the largest PFOSF producer in China. This enterprise would phase out its PFOSF production capacity and upgrade its capacity for production of other less toxic products. Based on the social screening carried out as part of the Environmental and Social Management Framework (ESMF) preparation, this is expected to have limited negative social impacts because it is planned that each affected employee will be reassigned to jobs within the company.

64. However, given that it is foreseen that some future project enterprises may partially or entirely close their PFOS production, there may be limited adverse social impacts related to involuntary resettlement and job changes or losses of a small number of workers as the project activities are carried out. During project implementation, a limited number of project enterprises may need to reduce production or a few enterprises may be relocated in line with local urban plans. To address potential relocation or partial closure with possible involuntary resettlement, a resettlement policy framework (RPF) and employee resettlement plan framework have been

prepared as part of the ESMF, based on surveys of some sample project enterprises and interviews with relevant stakeholders. The ESMF/RPF will be followed during project implementation.

65. To address potential job changes or losses which is foreseeable for a small number of workers at project enterprises, beneficiary enterprises will provide training, new job assignments within the same group of the company, and other kinds of assistance for affected workers. Chinese labor laws and regulations will be followed to ensure appropriate compensation and livelihood restoration to affected workers. The ESMF states that local Chinese labor laws and regulations, and World Bank safeguards policies should be followed to ensure appropriate compensation and livelihood restoration for affected people.

66. A social screening will be done for every subproject to assess social impacts and risks. A comprehensive social assessment will be done for every subproject which has negative social impacts and risks. A social assessment report will be done as required accordingly through hiring experienced professionals. In case of workers' redundancy with labor contract termination from the pilot enterprise, an employee resettlement plan should be prepared in consultation with professional expert and submitted to the Bank via FECO for prior review and agreement. The employee resettlement plan will be monitored and evaluated during the project implementation period. In the event that 20 or more employees would be laid off at one time by a project enterprise, according to the Chinese government labor regulation, a full employee resettlement plan should be prepared by the enterprise and reported to the local labor authorities. The plan should be submitted to the Bank team for prior review before actual layoff of staff of the related enterprise. In the event that less than 20 employees would be laid off, the enterprise should follow the Chinese government labor regulations, and prepare an employee resettlement plan, which will also be subject to prior review by FECO and the Bank team, and can be covered in the ESMF under OP 4.01. More details are provided in Annex 3.

67. The RPF and employee resettlement plan framework, as part of the environmental and social management framework, in both Chinese and English, was submitted to the Bank on July 30, 2016 and was found acceptable. The document has been locally disclosed through the internet on August 30, 2016 and the Bank InfoShop on September 7, 2016.

68. *Gender.* Gender consideration has been integrated in project design, in particular through the social assessment and ESMF. Women have more concerns about their health and that of their families related to PFOS. If they are affected by losing or changing jobs or by involuntary resettlement, they have different needs for livelihoods restoration, such as alternative skill training. Special needs of women shall be closely followed in accordance with labor laws in China. Women's opinions and participation will be considered in public consultations and citizen engagement activities during project implementation, e.g., supporting women's associations or joining trade union of project enterprises. Gender is embedded in the project Results Framework and gender disaggregated information on job training, employment assistance and other project benefits will be included in annual progress reports.

69. *Citizen engagement.* Citizen engagement was a key aspect of the project social assessment (SA) and ESMP. Public consultation will continue to draw on local people's views

and feedback on further subproject design and implementation. Consultations will continue with local residents (both men and women) on the needs for training and livelihoods restoration for affected people under the project. Information on potential social impacts and planned mitigation measures has been and will continue to be shared with the public. Citizen engagement is a part of the project's Results Framework through the following indicator: percentage of beneficiaries aware of project information and investments (for employees of PFOSF production enterprises under component 1 and of demonstration enterprises under component 2).

F. Environment (including Safeguards)

70. The project will involve demonstration activities to reduce the production and the use of perfluorooctane sulfonic acid (PFOS) and related salts, a family of chemicals that are toxic, extremely persistent and likely to be carcinogenic to humans. The industries to be targeted by the project, i.e., chemical industry, metal plating, pest management and fire protection are heavily polluting and energy/resource intensive. Given the highly complex environmental impacts and potentially significant risks, a category A is assigned as per the WB safeguard policy.

71. The project has overall positive environmental impacts as it supports phasing out or reducing the PFOS production and use and replacing with less toxic and persistent chemicals. Since demonstration activities mainly involve converting to other products, retrofitting or closing down within the existing factory, *impacts during construction* in most scenarios are foreseen to be confined within the facility. However, converting and retrofitting often requires dismantling part of the old equipment, reconfiguring pipeline system and/or factory space. Handling and disposal of spoil and scraps, some of which can be hazardous, could pose negative impacts on the environment and workers' health both on-site and off-site. This will be carefully assessed, planned and managed for such enterprises once selected during implementation.

72. *Impacts during operation* vary considerably due to the diverse set of sectors and subprojects involved. The ESMF describes succinctly the four sectors, their main processes and technologies, and associated major pollution and environmental issues. Typical for chemical intensive industries, these include air emissions of acidic and alkali chemicals as well as toxic fugitive emissions inside and outside workshops, and flue gas from boilers, water effluent high in non-biodegradable substances or heavy metals, inorganic sludge and solid wastes including hazardous wastes, and their final treatment and disposal off-site. Their improper disposal could contaminate surface water, ground water and soil over long term, enter into ecosystem and bioaccumulate in species, and threaten human health eventually.

73. For application in metal plating industry, *occupational health and safety risks* could occur with the improper use of substitutes for PFOS-containing chromium mist suppressants (CMS), since the latter has been effective in controlling harmful volatile emissions from metal plating solutions. For application of substitute pesticides in agriculture, improper use and storage could lead to safety risks and health hazards for farmers/users as well as soil and water contamination. For application of foam substitute in firefighting, foam chemicals could be washed away into the surrounding environment, causing contamination.

74. *Environmental Assessment (OP 4.01)*. Since most beneficiaries for demonstration can only be determined during implementation, a framework approach was adopted according to the Bank's safeguard requirements. An Environment Management Framework (EMF) has been developed under the detailed advice of the Bank team. It is designed to guide the screening and selection process, the evaluation of environmental issues and risks and the management of these risks for each sector/production line involved under various scenarios. It includes Terms of Reference (ToR) for all environmental safeguard instruments that might be needed and step-by-step instructions on when each instrument needs to be prepared and how. More details about the EMF can be found in Annex 3. The EMF and a Social Management Framework form the project's Environmental and Social Management Framework (ESMF).

75. Prior to appraisal one enterprise under consideration was Hengxin Company, a PFOSF producer willing to convert to the production of less toxic alternatives – its participation and details of investment plans would only be confirmed during project implementation. According to the current situation, an environmental audit was conducted under the close guidance of the Bank team. The results show that the factory is generally compliant with environmental requirements and criteria and meets concentration discharge standards, but exceeds allocated total pollution load for some parameters. The biggest risks however lie in the handling of chemicals and disposal of hazardous wastes. To tackle the problems and risks, an Environmental Management Plan (EMP) was included in the environmental audit report with specific measures to mitigate the impacts and risks. An Environmental Impact Assessment (EIA) will be prepared as soon as project support to Hengxin is confirmed and subproject details are identified.

76. *Pest Management (OP 4.09).* The project will support the retaining and use of alternative pest control agents to replace PFOS-based insecticides that have been the major means to control red imported fire ants in China. A Pest Management Plan (PMP) has been developed and annexed to the ESMF. The PMP highlights the principle of integrated pest management embodied by this OP while acknowledging the fact that non-chemical methods for controlling red fire ants are largely premature so far. As a result, the PMP focuses on a limited number of non-PFOS based insecticides, their safe storage, transportation and application. It includes a monitoring and training program for farmers and agricultural technicians.

77. *Public disclosure and consultation.* Two rounds of local disclosure of the ESMF have been conducted per the Bank requirement for category A project. The first round was conducted during March 2016 at the official websites of the central PMO and several sector associations. The second round took place in July 2016 after the complete draft ESMF with all its annexes was finalized. After each round of disclosure, public consultations were carried out through meetings with representatives of interested enterprises, branch associations of sectors involved, government agencies concerned at central and provincial levels, local PMOs, as well as academia and experts. For Hengxin Company, the only pilot identified prior to appraisal, its environmental audit report has been disclosed locally in the city through two rounds in June and August 2016 respectively, followed by consultation with local people to be potentially affected. The concerns and suggestions from all public consultations have been incorporated in the finalization of the ESMF and the environmental audit report. Both documents were publicly disclosed at the World Bank's external website on September 7 and September 6, 2016, respectively.

G. Other Safeguards Policies Triggered *(if required)*

60. No other safeguards policies are triggered

H. World Bank Grievance Redress

78. Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB noncompliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit http://www.worldbank.org/GRS. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

Annex 1: Results Framework and Monitoring

Country: China

Project Name: Reduction and Phaseout of PFOS in Priority Sectors (P152959)

Results Framework

Global Environmental Objectives

PDO Statement

The project development objective is to reduce PFOS in selected sectors and enterprises in China in a sustainable manner.

These results are at | Project Level

Global Environmental Objective Indicators

Indicator Name	Baseline	Cumulative Target Values					
		YR1	YR2	YR3	YR4	YR5	End Target
Amount of PFOS produced and used yearly reduced (Ton/year)	0	0	0	44	44	44	44
Control and monitoring system for tracking PFOSF production and sale established and operational (Yes/No)	No	No	Yes	Yes	Yes	Yes	Yes
Direct project beneficiaries (Number) - (Core)	0	0	0	7,200,000	7,200,000	7,200,000	7,200,000
Female beneficiaries (Percentage - Sub-Type: Supplemental) - (Core)	0	0	0	50	50	50	50

Intermediate Results Indicators

Indicator Name	Baseline	Cumulative Target Values					
		YR1	YR2	YR3	YR4	YR5	End Target
Amount of PFOSF production capacity dismantled or converted (Ton/year)	0	0	0	10	50	100	100
Number of PFOS secondary production enterprises that join stewardship program (Number)	0	0	2	3	5	10	10
Number of contracts signed with enterprises for demonstration of PFOS phase-out in the metal plating sector (Number)	0	2	12	20	20	20	20
Yearly reduction in water effluents containing PFOS from demonstration industrial parks (Ton)	0	0	0	240,000	480,000	720,000	720,000
Number of firefighting foam manufacturers developing non PFOS-based fire-fighting foam (Number)	0	1	2	3	3	3	3
Land area under demonstration for RIFA non-PFOS alternative treatment (Hectare)	0	0	250	500	750	1,000	1,000
Number of PFOS related environmental standards developed	0	0	0	1	3	5	5

(Number)							
Intended beneficiaries aware of project info. and project investments (%) (Percentage) - (Core)	0	0	0	75	80	85	85
Intended beneficiaries aware of project info. and project investments - female (Number - Sub-Type: Supplemental) - (Core)	0	0	0	300	320	340	340
Intended beneficiaries aware of project info. and project investments –male (Number - Sub-Type: Supplemental) - (Core)	0	0	0	900	960	1020	1020
Intended beneficiaries - female (number) (Number - Sub-Type: Supplemental) - (Core)	0	0	0	400	400	400	400
Intended beneficiaries - male (number) (Number - Sub-Type: Supplemental) - (Core)	0	0	0	1,200	1,200	1,200	1,200

Indicator Description

Global Environmental Objective Indicators

Indicator Name	Description (indicator definition etc.)	Frequency	Data Source / Methodology	Responsibility for Data Collection
Amount of PFOS produced and used yearly reduced	This indicator measures progress towards reduction of PFOS production and use in various sectors. Target corresponds to 2015 production for exempted usage (metal plating, oil production and RIFA) as reported in the CS-1 consultant project preparation report, that will no longer be allowed after 2019. As there is no export or import of PFOSF the amount produced and amount used are equivalent. The baseline is zero. Target values for years 1 and 2 remain zero due to inability to verify data before 2019, though in reality production/use is expected to decrease already.	Semi-annual	MIS	PMOs
Control and monitoring system for tracking PFOSF production and sale established and operational	This indicator will show that a system is in place to measure and report on sustainability of project outcomes. Based on annual reporting requirement for PFOSF production and sales as part of implementation agreement with Hubei and arrangement with MPS will track allowed production and sale to registered users only.	Semi-annual	MIS	FECO PMO with input from Hubei PMO
Direct project beneficiaries	Direct beneficiaries are people or groups who directly derive benefits from an intervention. Direct beneficiaries are assumed to include the number of workers in 4 enterprises with PFOSF production in	Semi-annual	PFOS registration and reporting system, MIS	PMOs

	2015; people living in the counties where these production facilities are located; number of workers in metal plating demonstration enterprises; number of workers in participating foam manufacturers; and number of people previously spraying sulfluramid in project demonstration areas. The actual number of beneficiaries is expected to be higher, but is impossible to estimate given the distribution of PFOS in the global environment.			
Female beneficiaries	Based on the assessment and definition of direct project beneficiaries, specify what percentage of the beneficiaries are female.	Semi-annual	MIS	PMOs

Intermediate Results Indicators

Indicator Name	Description (indicator definition etc.)	Frequency	Data Source / Methodology	Responsibility for Data Collection
Amount of PFOSF production capacity dismantled or converted	Based on total EIA capacity of 5 PFOSF production enterprises to be dismantled plus 3 enterprises to convert capacity. The target is related to, but different than the PDO indicator, given the EIA capacity for PFOSF production is greater than the 2015 baseline of use for exempted applications which is the basis for the PDO indicator above.	Semi-annual	PFOS registration and reporting system, MIS	FECO and Hubei PMOs
Number of PFOS secondary production enterprises joined stewardship program	This indicator will measure the number of secondary PFOS production enterprises which join the stewardship scheme that aims to promote phase-out of PFOS production, to be established by the project.	Semi-annual	Stewardship program data	FECO PMO

Number of contracts signed with enterprises for demonstration of PFOS phase-out in the metal plating sector	Representing at least 17 hard-plating, 2 closed-loop, and 1 decorative plating enterprises. Baseline is zero.	Semi-annual	MIS	FECO and Guangdong PMOs
Yearly reduction in water effluents containing PFOS from demonstration industrial parks	This indicator will measure success of improvement of wastewater treatment operations in at least three selected industrial parks. Based on estimated 800 m^3 discharge per day per park for 300 days a year.	Semi-annual	EPB assessment data; Environmental monitoring reports	FECO and Guangdong PMOs verification
Number of firefighting foam manufacturers developing non PFOS-based fire-fighting foam	This indicator measures the progress towards uptake of non PFOS fire-fighting foam.	Semi-annual	MIS	FECO PMO
Land area under demonstration for RIFA non-PFOS alternative treatment	This indicator measures the area of land (in ha) in which red imported fire ant non-PFOS alternative treatment has been piloted. Based on 8 total demonstration sites in 5 provinces covering 32 ha each (500 mu) and repeated in new sites for 4 years. Baseline is zero.	Semi-annual	MIS	FECO PMO based on reporting from NATESC
Number of PFOS related environmental standards developed	A number of standards are proposed to be developed as part of TA activities. Baseline is zero.	Semi-annual	MIS	FECO PMO
Intended beneficiaries aware of project info and project investments (%)	This indicator intends to measure the effectiveness of consultation and communication mechanisms in terms of ensuring that information about the project and project supported investments have been communicated effectively – it applies to employees of participating enterprises only as it could not be meaningfully applied to all beneficiaries; based on 4	Semi-annual	Social safeguard monitoring	FECO, Hubei and Guangdong PMOs

	enterprises with PFOSF production in 2015 under component 1 and demonstration enterprises under component 2.			
Intended beneficiaries aware of project info. and project investments – female	This indicator intends to measure the effectiveness of consultation and communication mechanisms in terms of ensuring that information about the project and project supported investments have been communicated effectively - it applies to female employees of participating enterprises only as it could not be meaningfully applied to all beneficiaries; estimate based on 4 enterprises with PFOSF production in 2015 under component 1 and demonstration enterprises under component 2.	Semi-annual	Social safeguard monitoring	FECO, Hubei and Guangdong PMOs
Intended beneficiaries aware of project info. and project investments –male	This indicator intends to measure the effectiveness of consultation and communication mechanisms in terms of ensuring that information about the project and project supported investments have been communicated effectively – it applies to male employees of participating enterprises only as it could not be meaningfully applied to all beneficiaries; estimate based on 4 enterprises with PFOSF production in 2015 under component 1 and demonstration enterprises under component 2.	Semi-annual	Social safeguard monitoring	FECO, Hubei and Guangdong PMOs
Intended beneficiaries - female (number)	The assumed number of intended female beneficiaries include the number of workers in participating enterprises – estimated at appraisal based on 4 enterprises considered under component 1	Semi-annual	Social safeguard monitoring	FECO, Hubei and Guangdong PMOs

	with PFOSF production in 2015, and demonstration enterprises under component 2.			
Intended beneficiaries - male (number)	The assumed number of intended male beneficiaries include the number of workers in participating enterprises – estimated at appraisal based on 4 enterprises considered under component 1 with PFOSF production in 2015, and demonstration enterprises under component 2.	Semi-annual	Social safeguard monitoring	FECO, Hubei and Guangdong PMOs

Annex 2: Detailed Project Description

CHINA: REDUCTION AND PHASEOUT OF PFOS IN PRIORITY SECTORS (P152959)

Strategy for PFOS phase-out in China

1. The proposed project will assist China to reduce and eliminate the use of PFOS in priority sectors. It will focus on control and monitoring the supply chain of PFOSF, which is the primary material used for producing secondary materials for various end-use applications. PFOSF is used mainly for production of PFOS-based surfactants for firefighting foam, PFOS-based chromium mist suppressants, sulfluramid for pesticide control purposes, and PFOS-based surfactants for enhanced oil recovery applications.

2. There are historically 12 PFOSF manufacturers in China. Some of them are manufacturing both PFOSF and secondary PFOS-based products. The survey conducted during the preparation of this project also confirmed that while there were still 9 companies producing PFOSF in 2014, there were only four active companies in 2015. The other PFOSF producers had stopped producing PFOSF, some limiting their manufacturing activities to production of secondary PFOS products by purchasing PFOSF from other producers or traders. The project will provide financial and technical support to PFOSF producers and producers of secondary PFOS-based products to close their facilities in an environmental sustainable manner or convert their existing facilities to produce alternatives that pose less risk of adverse effect on human health and the environment. The project will work with the industry association to share experiences across the sector.

3. To ensure sustainable reduction of PFOSF and preempt future diversion of PFOSF to banned applications after 2019, the project will establish a registration and reporting system to track the flow of PFOSF to downstream industry, through registration of PFOSF manufacturers, manufacturers of PFOS-based surfactants, and PFOS-based firefighting foam. Given that the use of PFOS in pesticide control, oil extraction and CMS will not be allowed, PFOSF should only be supplied to manufacturers of surfactant for firefighting, or in small amounts for other acceptable uses[7].

4. The registration and reporting system would impose a reporting requirement on the remaining PFOSF producer that would be subject to verification by the local EPB. Surfactant manufacturers and others planning to produce PFOS-based products for acceptable use after 2019 would have to register with local EPBs, and any sales of PFOSF after 2019 would be allowed only to registered companies and reported to MEP. Moreover, firefighting foam manufacturers using PFOS-based surfactant will also be required to register with local EPBs and the Ministry of Public Security, and report on the amount of PFOS-based surfactant purchased and their suppliers, as well as the quantity of PFOS surfactant contained in firefighting foam sold to their respective clients.

[7] Photo-imaging, photo-resist and anti-reflective coatings for semi-conductor, etching agent for compound semi-conductor and ceramic filter, aviation hydraulic fluids, hard metal plating in closed-loop systems, certain medical devices (such as ethylene tetrafluoroethylene copolymer (ETFE) layers and radio-opaque ETFE production, in vitro diagnostic medical devices, and CCD color filters). Excluding metal plating, all other uses of PFOF amounted to less than 0.9% 2015

5. To eliminate demand for PFOS-based products, the project will finance several activities to develop and demonstrate effective use of non-PFOS based alternatives in the metal plating industry, firefighting applications, and pesticide control. These applications cover approximately 75 percent of the total PFOSF demand in China based on 2015 data[8] available to the team – see Table below synthesizing the information from the study conducted as part of project preparation. In addition, the project will finance development of policy, regulations, standards, guidelines, and best practices, to ensure proper screening of new alternatives so that the use of new alternatives would not lead to unforeseen adverse environmental and health impacts.

Table 1: Synthesis of PFOS Consumption in Four Main Applications, 2015

Application	PFOSF consumption (ton)
Metal plating	17
Fire protection	61
Pest control	1
Oil recovery	26
Total	105

6. Through introduction of new alternatives and technologies for chrome plating industry, inclusion of non-PFOS-based chromium plating process in the cleaner production regime for the industry, and demonstration of new less harmful alternatives in industrial parks, large and small chrome plating manufacturers would be able to learn from these showcases and select types of technologies that are appropriate to their circumstances. For pest control, the project will work with relevant authorities to introduce and conduct field test of new non-PFOS-based pesticides/baits for control of red imported fire ants. Given that pesticides for this application are only procured by the Government, successful introduction of non-PFOS alternatives by this project would ensure sustainable phase-out of sulfluramid in this application. Finally, while PFOS would be still allowed for use in firefighting application after 2019 as it is an acceptable use, the project will greatly assist China to reduce the use of PFOS based firefighting foam by promoting development of alternatives.

7. Activities to be financed by the project are categorized into four components, as follows.

Component 1: PFOS Production Reduction (GEF US$5.1 million; cofinancing US$20 million)

8. Three types of interventions are anticipated to address PFOSF and PFOS production:

(a) Conversion of production to non-PFOS/non-PBT (persistent bio-accumulative and toxic) chemicals;
(b) Plant or production line closure; and
(c) Promotion of cleaner production.

[8] *PFOS phase-out plan in Chinese priority industries*, background report for the preparation of the project, Tsinghua University and Shenyang Academy of Environmental Sciences, 2016.

9. *Conversion of production facilities*: This component will finance conversion of PFOSF production facilities and offer incentives to support approximately ten additional downstream PFOS manufacturers in switching to new non PFOS-based products. It is expected that new products would be manufactured based on the existing electrochemical fluorination (ECF) production technology. The project would not finance any production of chemicals known to possess PBT characteristics. Eligible incremental expenditures would include: (a) development of non-PFOS products; (b) costs related to registration of new products; (c) equipment and technology transfer costs; (d) installation; (e) training; (f) trial production; (g) incremental costs of new raw materials, utilities, waste management; required for conversion to non-POP products; and (viii) costs of disposal of contaminated equipment previously used for producing or storing PFOS.

10. *Plant or production line closure*: GEF incremental support would be extended to an estimated two enterprises that might decide to close down their production facility altogether. GEF resources will be used to support management of environmental liabilities from such closure. Eligible incremental expenditures would include: (a) dismantling costs; (b) disposal costs of contaminated equipment and materials; and (c) consulting services to develop site risk assessment, management and monitoring plans. Remediation beyond disposal of contaminated equipment is expected to be financed by other sources outside of the project.

11. *Promotion of cleaner production:* In line with BAT/BEP requirements under the Stockholm Convention, the project would promote introduction of cleaner production techniques and practices so as to limit the risks of environmental releases or to worker's health and safety resulting from PFOSF production. Eligible expenditures include: (a) consulting services to develop site specific CP audits; (b) modification of production lines in accordance with CP measures; and (c) training. The project would also promote phase-out at downstream producers through support to a "MEP PFOS stewardship program", including strengthening of label specification.

Component 2: Reduction of PFOS Use (GEF US$8.12 million; cofinancing US$4.47 million)

12. *Component 2A: Metal Plating Sector*: The main purpose for the use of chromium mist suppressant (CMS) is to prevent workers from being exposed to the highly toxic Cr(VI) and to prevent air emissions of Cr(VI) from the electroplating process into the environment. The total PFOSF consumption for chrome plating was estimated as 17 tons in 2015. The electroplating industry consists of over 6,000 companies of which 4,400 are using chromium for electroplating and approx. 1,000 are using PFOS based CMS. Of the 1,000 companies, 900 to 950 are small and medium size enterprises, and 50 to 100 are larger size enterprises. As per the national industrial policies, electroplating enterprises are required to move into industrial parks where there are proper wastewater treatment facilities that meet environmental standards and local regulations pertaining to industrial discharge.

13. Consistent with the BAT/BEP Guidelines for the Stockholm Convention, the following actions will be undertaken by the project:

(a) Decorative chrome plating:

- Installation of ventilation systems;
- Use of Chromium (III);
- Use of non-PFOS CMS; and
- Use of F-Free CMS.

(b) Hard chrome plating:

- Use of a closed-loop system and non-PFOS CMS;
- Installation of ventilation systems;
- Use of non-PFOS CMS; and
- Use of F-free CMS.

14. As an effort to eliminate or reduce the use of PFOS chromium mist suppressants, the project will finance demonstration activities to show case non-PFOS alternatives and closed-loop systems, with equivalent or improved efficacy in terms of protection of human health and safety. The demonstration activities will include installations of approx. two closed-loop systems from different chrome-plated products and introduction of non-PFOS alternatives in at least 20 companies using chromium mist suppressant for manufacturing various products in three industrial parks. There are a total of 40 – 50 enterprises in the country who could be potential candidates for investing in closed-loop systems, and for post-project replication, based on their size and environmental management capacity. The industrial parks will be selected during the project implementation. Criteria for selection of these industrial parks would include the number of chrome plating enterprises, environmental management capacity of the industrial parks, and willingness to show case demonstration activities to similar industry in other industrial parks.

15. The project will finance costs in relation to acquiring of the following: (a) upgrade of facilities to closed-loop systems; (b) chrome plating baths replacement; (c) new chromium mist suppressant; (d) other equipment, testing device, and control systems related to the use of new alternatives; (e) ventilation and safety equipment; (f) site preparation for installation of new equipment; (g) replacing Cr(VI) with Cr(III) which will eliminate the use of chromium mist suppressant altogether; and (h) advanced treatment facilities for up to three industrial parks for removing PFCs from water discharge from chrome plating industry.

16. *Component 2B: Firefighting Foam Formulation* – There are 67 firefighting foam manufacturers with licenses to produce various types of firefighting foam in China. Out of these 67 manufacturers, 10 of them consume more than 80 percent of the total PFOS in this sector. PFOSF use for the production was approx. 61 tons in 2015.

17. The project will finance development and production of non-PFOS firefighting foam as demonstration projects at 3-5 firefighting foam manufacturers. The selection criteria of firefighting foam manufacturers would include: (a) research and development capacity; (b) relevant experience with firefighting chemicals; (c) large network of firefighting foam clients; (d) good environmental performance record; (e) in-house capacity to develop non-PFOS surfactants or technical cooperation with reputable surfactant manufacturers; and (f) cost effective proposals.

18. The following costs will be covered by the project: (a) research and development of new non-PFOS based firefighting foam; (b) environmental and health impact evaluation of new alternatives; (c) new equipment for manufacturing non-PFOS based firefighting foam; (d) site preparation for installing new equipment; (e) tanks and storage facilities; (f) testing efficacy of new products; (g) registration of new surfactants and firefighting foam; and (h) costs of raw materials, utilities, waste treatment, and other costs related to development of new firefighting foam.

19. In addition, the project could consider financing costs of new non-PFOS firefighting foam needed for training at 3 training facilities of the Ministry of Public Security. To preempt environmental impact from training exercises, proper treatment facilities for water discharge from firefighting training could then be financed by the project in line with the ESMF. Funding could also be used to cover costs of firefighting equipment retrofit or procurement of new equipment for training purposes.

20. *Component 2C: Pesticides for termite, RIFAs and pest control* – The project will finance the purchase of pesticides for demonstration of a two-phase treatment method using bait and powder to control red imported fire ants. Pesticides to be financed by the project include 6 tons of indoxacarb-based baits, 3 tons of cypermethrin-based baits, and a small amount of hydramethylnon. The demonstration activities proposed in this project which are described under component 3 aim to eliminate the use of sulfluramid, a PFOS-based insecticide used in a variety of pest control including red imported fire ants.

Component 3: Policy and Technical Assistance (US$9.88 million; cofinancing US$17 million)

21. Consistent with its obligations under the Stockholm Convention, China has restricted new construction of PFOS production facilities by including PFOS in the list of chemicals in the *National Industrial Restructuring Guidance Catalogue* in 2013. Similarly, MEP also included PFOS as "high pollution/high environmental risk" product in the *Comprehensive Environmental Protection Directory* in 2013. Subsequently, MEP along with all the ministries that are members of the National Coordination Group for Stockholm Convention Implementation jointly issued a notice for banning the use of PFOS in applications not included in the list of acceptable applications and exempted uses in March 2015. In the same year, MEP included PFOS in the new version of the Catalogue of Hazardous Chemicals.

22. To support implementation of the above regulations, as well as to support the ban on the use of PFOS in exempted uses, including PFOS use in metal plating industry, pesticide control, and oil extraction industry, technical assistance activities to address specific standards and regulations addressing these sectors will be financed by the project. These technical assistance activities will also assist China to develop technical description and guidelines related to PFOS waste. These efforts directly support the overall objective of the project to reduce or eliminate the use of PFOS without compromising productivity, safety and product quality in industry and agricultural activities in China, while minimize any adverse impact on environment or human health of alternatives. The following activities are envisaged.

23. *Standards and Regulations:* The following, but not limited to, activities would be carried out: (a) labelling scheme to ensure that commercially available chromium mist suppressant will have to be properly labelled, with clear indication of content -whether PFOS or not; (b) development of technical specifications for chromium mist suppressants, including efficacy in protecting human health and safety; (c) standards defining PFOS waste, and related best practices for disposal; (d) specification of discharge of waste water containing PFOS for electroplating industry; and (e) development of guidelines for use of safer alternatives for the oil sector. Workshops, training, and publications would be financed by the project to disseminate experiences and lessons learned and promote the new standards and regulations, in particular for the whole chrome plating industry in China, in close cooperation with relevant industry associations.

24. *Screening of non-PFOS alternatives*: There are potential non-PFOS alternatives available for different applications addressed by this project. However, the Government of China would like to ascertain that any new non-PFOS alternatives to be introduced in China should not have PBT characteristics. A PBT screening system for new chemicals will be established. These include, among others: (a) guidelines for registration of new chemicals including reporting requirement on PBT characteristics; (b) development of standard testing protocol for determining PBT characteristic of organofluorine chemicals; (c) screening reports on PBT characteristics of at least 10 non-PFOS chromium mist suppressants; and (d) research and development of non-PFOS firefighting foam.

25. *Technical studies*: A series of studies will be carried out under the project to enhance understanding of import/export control of PFOS, and of PFOS use as CMS in electroplating factories in Guangdong province. To guide the chrome plating industry in the future as part of the efforts to sustain achievement of this project, the project will finance the testing of mist suppression performance of alternatives and develop a list of acceptable chromium mist suppressants. Findings from screening of non-PFOS alternatives in the subsequent section will be employed when developing this list. A preliminary study on health impact of PFOS will also be conducted, which would be a first step towards scoping the problem, and could lead to further work to better understand the costs to human health and environmental degradation from POPs and hazardous chemicals in China, and the benefits to society from addressing these. This study would build on the preliminary work undertaken to outline project benefits in the context of the project's economic analysis.

26. *Technical Assistance to reduce the use of PFOS in firefighting*: The project will support testing the safety and efficacy of alternative non-PFOS firefighting foams and products; devising technical way forward for substitution of PFOS in the firefighting sector; revising relevant standards as needed; capacity development to detect PFOS substances in foam extinguishing agents; and strengthening the tracking and control of PFOS containing firefighting agents. Testing of alternatives will include small scale screening of products followed by large scale testing of efficacy and safety of alternative products/technologies, and testing of foam firefighting characteristics and biodegradation, toxicity and other health and environment related properties. The project will support capacity development for PFOS management and control through upgrade of equipment to detect PFOS substances in foam extinguishing agents, and development of a standard detection methodology for PFOS substances for the firefighting

sector. Hardware and software will be supported to develop an information system to keep track of PFOS contents in foam extinguishing agents, and generate relevant data and reports to track any illegal production, sell, use or disposal. Since a large quantity of PFOS firefighting foam is used for training, adopting new non-PFOS alternative foam could lead to permanent reduction of a significant quantity of PFOS. The project would therefore finance revision of firefighting protocols and training manuals for effective use of new non-PFOS firefighting foam without compromising safety and health of firefighting cadets.

27. *Cleaner Production:* The project will extend the current cleaner production regime in China to include PFOS and metal plating industry. Activities to be financed by the project include: (a) development of good practices and guidance for the organofluorine chemicals industry as basis for a cleaner production index assessment system; and (b) revision of cleaner production audit indicator system for the electroplating industry, to include PFOS in Guangdong Province; and (c) elaboration of an industry stewardship program for the organofluorine related chemicals industry in collaboration with relevant industry associations.

28. *Technical Assistance to eliminate the use of PFOS for control of RIFA*: Following the Pest Management Plan, the project will finance the demonstration of a two-phase treatment method using 0.1 percent and 0.05 percent indoxacarb bait and 0.1 percent alpha-cypermethrin powder, followed by 1 percent hydramethylnon bait if necessary after the treatment, to control red imported fire ants. This method will be demonstrated over four years in 5 provinces, with two demonstration areas in each of the Guangdong, Fujian, and Guangxi provinces, and one demonstration area each in Hainan and Guizhou provinces. Each demonstration site will cover a land area of 500 Mu (approx. 33 hectares), so that year demonstration activities will cover a total land area of 4,000 Mu in 5 provinces. Each area will be subjected to only one demonstration. Each demonstration will last two months. In the subsequent years during the project implementation period, new land areas in the same provinces will be selected for demonstration.

29. In addition, the following technical assistance activities will be conducted: (a) training and dissemination of experience from the field demonstration; (b) development of TV documentary, poster, booklets and website to raise public awareness about alternatives to sulfluramid for RIFA control; (c) development of policies and strategies to phase out sulfluramid use for RIFA control and expedite registration of pesticides for controlling of quarantine pests; (d) preparation of technical guidelines for control of RIFA and list of pesticides for control of RIFA and their methods of use; (e) conduct laboratory and field experiment to screen alternative pesticides; (f) revision of agricultural industry standard; and (g) workshops on RIFA control and phase-out sulfluramid, and enhancement of pesticide supervision capacity.

30. *PFOS registration and reporting system:* The project will strengthen capacity of MEP and local EPBs to enforce its regulations and monitoring requirements for hazardous substances. A reporting system will be developed to support registration of producers of PFOSF, secondary PFOS based product manufacturers, and users of PFOS products in firefighting foam industry. The system will assist China to monitor production and supply of PFOS materials from sources to end users. Technical capacity of local EPBs will be strengthened to enable them to carry out or supervise factory audits to prevent any diversion of PFOSF to banned applications. Efforts would mainly focus on strengthening capacity of local EPBs in Fujian and Hubei to control the

PFOS supply chain. Success and lessons learned would then be disseminated to Guangdong and other provinces, where needed.

Component 4 – Project management (GEF US$ 1.15 million; cofinancing US$ 1.5 million)

31. Component 4 will finance the costs of operations of the three project management offices at FECO, Guangdong EPB and Hubei EPB, as well as Monitoring and Evaluation, and coordination activities. Eligible costs include expenditures incurred by the PMOs in carrying out the project, including cost of travel, printing, communication, office equipment and supplies, service contracts for office equipment and utilities, and public awareness materials.

Annex 3: Implementation Arrangements

CHINA: Reduction and Phase-out of PFOS in Priority Sectors

Project Institutional and Implementation Arrangements

1. The Foreign Economic Cooperation Office (FECO) under the MEP will serve as the overall national implementing agency for the project which will be implemented by the three PMOs - one housed in FECO, one in Guangdong and one in Hubei Environmental Protection Bureaus (EPBs).

2. Guangdong PMO will be housed in the Publicity, Education, Exchange and Cooperation office of the EPB to manage implementation of demonstration activities of PFOS phase-out in metal-plating sector. Hubei PMO is housed in the Solid Waste Management and Chemical Center of Hubei EPB. It will be responsible for the day-to-day management of activities related to closure/conversion of PFOSF production lines in Hubei Province. FECO PMO will implement national level activities and supervise project implementation by the two PMOs and consolidate project progress and financial reports. FECO PMO will implement other activities outside of Guangdong and Hubei provinces, in particular in Fujian, Hainan, Guizhou, and Guangxi, with technical experts dispatched to the four provinces to guide project implementation.

3. Overall project implementation in the two pilot provinces will be guided by steering committees with representation from environmental protection authorities and involvement of other authorities, technical experts from industry associations and universities on as needed basis. In addition, Hubei has also established a working group that consists of the technical specialists from the Solid Waste Management (SWM) and Chemical Center, and two municipalities where the PFOSF production entities are located, to guide the technical aspects of project implementation.

4. To ensure strong stakeholder involvement at the national level, the existing inter-ministerial National Coordinating Group (NCG) for implementation of the Stockholm Convention on POPs will continue to provide overall guidance and coordination for implementation of the project and to facilitate adoption of national level regulations as early as possible. The NCG was established by the State Council and composed of 14 ministries and commissions. These include MEP (as the chair of the NCG); Ministry of Foreign Affairs; National Development and Reform Commission; Ministry of Industry and Information Technology; Ministry of Science and Technology; Ministry of Finance; Ministry of Housing and Urban-Rural Development; Ministry of Agriculture; Ministry of Commerce; National Health and Family Planning Commission, General Administration of Customs; General Administration of Quality Supervision, Inspection and Quarantine; State Administration of Work Safety; and State Electricity Regulatory Commission.

5. The NCG's responsibilities include review and implementation of national guidelines and policies concerning POPs management and control, coordination, and review and approval of annual work plans for implementation of the NIP. FECO will organize NCG meetings at least once a year to report and collect feedback/comments on project implementation.

Project administration mechanisms

6. An Implementation Agreement will be signed between FECO as the national implementing agency and the two PMOs, to set out roles and responsibilities pertaining to implementation, monitoring and reporting requirements, the GEF grant amount to be allocated to the activities managed by the respective PMO and counterpart funding (incl., in-kind contributions). Each PMO, local PMOs and FECO PMO, will designate a procurement, financial management and safeguard specialist to ensure that activities conducted by each PMO are in compliance with the Bank's fiduciary requirements.

7. One Designated Account will be centralized at FECO and maintained in USD, while further advance will apply to Operating Accounts (OA) in RMB maintained by Hubei and Guangdong PMOs with fixed ceilings. The ceilings of two OAs will be determined according to the Designated Account (DA) ceiling as well as the allocated GEF amount and disbursement plan against Guangdong and Hubei. The OAs may serve all the eligible expenditures incurred by Guangdong and Hubei PMOs, if needed. To monitor the use of GEF funds, local PMOs are required to submit an interim financial reports to FECO. FECO would consolidated those reports including IFR of FECO's PMO to the Bank on a semi-annual basis.

8. Funds for component 1 and component 2 of the project would be mostly channeled to beneficiary enterprises through tripartite sub-grant agreements between FECO, respective PMOs and beneficiaries. FECO will support calls for proposals and appraisal of sub-projects, make payments under these sub-projects directly from the Designated Account. The Hubei and Guangdong PMOs would continue to be responsible for supervision including implementation of relevant safeguards measures, completion reporting, as well as reviewing requests for payment and advising FECO accordingly.

9. For implementation of component 3 activities related to the phase out of PFOS in the fire-fighting foam production sector, FECO will contract the China Certification Center for Firefighting Products (CCFP). CCFP is affiliated to the Ministry of Public Security (MPS) and is the only institution mandated to regulate commercialization and quality control of firefighting products in China. By law, CCFP is entrusted as the only institution to carry out third-party assessments of firefighting products, and provide mandatory certification based on technical evaluation of firefighting products' conformity with standards and regulations. The center has extensively participated in the firefighting related work of the national standardization technical committee, and is a focal point for a number of efforts related to product quality supervision and inspection. It also is responsible for maintaining and operating the MPS governmental website "Chinese Firefighting Products Information". As such, CCFP is an institution that possesses the unique mandate and the necessary management authority, cross-department coordination capacity and unique technical capacity to assess and certify the quality of non-PFOS based alternative firefighting products and technologies, and assess production needs and track sales of related products.

10. For pest control demonstration activities under component 3, FECO will sign a contract with the National Agricultural Technology Extension Service Center (NATESC) under the

Ministry of Agriculture, given their unique expertise and mandate, for demonstration activities in 5 provinces and design of the 'training of trainers' program and coordinating 'training for trainers' planning. NATESC would be responsible for establishing a team capable of design of demonstration activities, applying the pesticides and monitoring of results.

11. NATESC is a center directly affiliated to the Ministry of Agriculture (MOA) with responsibility for testing, demonstrating and promoting farm-oriented goods and materials, including pesticides, and organizing and implementing monitoring and prevention of serious pest damage. In 1995, MOA entrusted NATESC with the responsibility for domestic plant quarantine work, which among other includes the control of RIFA outbreak monitoring, prevention and control. NATESC has unique and extensive experience with national level inter-provincial monitoring, prevention and control of RIFA. Since 2005, at the outset of RIFA outbreak in Wuchuan, Guangdong Province, NATESC became the institute responsible for formulating and implementing RIFA control schemes, inspecting and supervising RIFA control in infested areas, organizing experts to deliver technical advice and on the spot guidance, and verifying the spread and eradication of RIFA. NATESC has successfully launched a series of research on RIFA control schemes suitable for Chinese characteristics, and was rewarded a First Prize of Science and Technology by the Chinese Association of Plant Protection in 2014 accordingly. NATESC is uniquely suited therefore to carry out activities under this project in the area of RIFA control that include demonstration, training, advocacy, substitute pesticides screening and promulgation of supportive policy, as this demands full collaboration among different sectors of plant quarantine, agricultural extension, scientific research, pesticide management and pest control implementation.

Financial Management, Disbursements and Procurement

12. The main financial management (FM) risks identified include: (a) the GEF financing under sub-grant will be used for sub-projects executed by several selected beneficiaries which may result in the grant proceeds not being used in an economical and effective way for the defined eligible expenditures; (b) Guangdong and Hubei PMOs lack experience in managing the Bank operations. To address the above risks, the following risk management measures have been agreed: (a) preparation and issuance of a Financial Management Manual, including sub-grant implementing arrangements, as part of the Project Implementation Manual, acceptable to the Bank, to standardize project FM procedures; (b) in addition to extensive FM training from the Bank, FECO who has extensive experience with the Bank operations will arrange more workshops and experience sharing events for local agencies; (c) FECO as the central PMO shall carry out semi-annual FM supervision to the subprojects implemented by provincial agencies especially during the initial one or two implementing year(s).

13. The project will be implemented by FECO PMO, Hubei PMO and Guangdong PMO who will be responsible for daily project FM work for what they execute. Each implementing agency has assigned one FM team comprising one manager, one accountant and one cashier from their existing financial departments. In addition, sub-grants are to be implemented by several beneficiary enterprises. To ensure efficient and effective project financial management, the sub-grant related FM functions, including project accounting and financial reporting, will be centralized at the two Provincial PMOs and the FECO PMO. Meanwhile, each of the sub-grant implementing entities is required to assign one FM staff member as a focal point to be

responsible for collecting and maintaining project accounting documents, doing separate bookkeeping of the sub-grant activities and preparing the payment request as well as reconciling with the relevant PMOs on a regular basis.

14. Overall, the residual project FM risk after mitigating measure is assessed as substantial.

15. *Budgeting.* The annual Project Implementation Plan (PIP), including the funding budget, will be prepared by each implementing agency. Budget variance analysis will be conducted on a semi-annual basis by the three implementing agencies to identify significant variances from plan that may need corrective actions. The Bank will work with the implementing agencies to supervise the project budgeting system, to enhance budget preparation, and budget execution reporting during project implementation.

16. *Funds flow.* The GEF grant will flow from the World Bank into the designated account opened and maintained by FECO. Further advance from the DA will be made into two segregated Operating Accounts (OAs) maintained by Guangdong and Hubei provincial EPBs and established at commercial banks acceptable to the Bank. The OAs will be maintained in RMB. The ceiling of further advance for each OA will be RMB3,500,000. The usage of further advances will be reported to FECO and the outstanding advances in the OAs will be reconciled with the DA whenever the two provincial PMOs submit withdrawal applications to FECO for OA replenishment. Any excessive further advances in OAs, which cannot be fully used by the end of the project or at any time that the further advance is terminated, must be returned to the DA and may be reallocated to other project activities. The further advance may cover whole project activities financed by the grant proceeds or specific eligible project activities concurred by FECO and provincial PMOs.

17. The GEF grant will be: (a) directly paid from the Bank to contractors or reimbursed from the Bank to implementing agencies for the portion financed by the grant proceeds paid by the agencies first, or (b) reimbursed from DA or OAs to implementing agencies or directly paid from OAs to contractors.

18. Supporting documents required for Bank disbursements will be prepared and submitted by the two PMOs to FECO for review before sending to the Bank further processing.

19. *Accounting and financial reporting.* The administration, accounting and reporting of the project will be set up in accordance with Circular #13: "Accounting Regulations for World Bank Financed Projects" issued in January 2000 by the Ministry of Finance (MOF). The standard set of project financial statements has been agreed between the World Bank and MOF.

20. The three PMOs will be responsible for daily project FM work, including project accounting and financial reporting. The FM function for performance-based sub-grants will be centralized at the two provincial PMOs and at the FECO PMO. The original accounting documents will be retained by each PMO maintaining all project accounting records. The project consolidated financial statements will be prepared by FECO, and will be submitted to the Bank for review and comment on a regular basis. The consolidated unaudited project interim financial reports (IFRs) will be prepared and furnished to the Bank by FECO no later than 45 days following each semester (the due dates will be August 15th and February 15th), in form and substance satisfactory to the Bank.

21. The computerized accounting system, Yongyou has been adopted by Guangdong and Hubei PMOs. The computerized accounting system to be used for this project has been widely

used and is working well in China, including under China's World Bank projects. FECO is using a self-developed computerized accounting system which has been successfully used in Bank operations for years. A separate project accounting profile will be set up in the existing system according to the requirements of Circular#13. A tailored chart of accounts to accommodate the project features has been elaborated in the FMM agreed with the Bank.

22. The task team will monitor the accounting process, including the adequacy of the financial management system, especially during the initial stage, to ensure complete and accurate financial information is provided in a timely manner.

23. *Internal control.* The FECO, Guangdong EPB and Hubei EPB have adequate financial management regulations in place. In addition, the project related accounting policy, procedures and regulations were issued by MOF, and the FMM will be prepared and issued to standardize the project FM procedures. For the sub-grant, measures to ensure robust internal control are addressed in the section on disbursement.

24. *Audit.* The Audit Service Center of the China National Audit Office (CNAO) for Foreign Loan and Assistance Projects has been identified as the project auditors. The auditors have extensive experience with the Bank financed operations. According to the World Bank Policy on access to Information, the audit reports for all investment lending operations for which the invitation to negotiate was issued on or after July 1, 2010, need to be made publicly available in a timely fashion and in a manner acceptable to the Bank. Audit reports will be made publicly available on the website of CNAO or the provincial auditors. Following the World Bank's formal receipt of the audited financial statements from the borrower, the World Bank will also make them available to the public in accordance with the World Bank Policy on Access to Information. The responsible agency and timing is summarized as follows:

Audit Report	**Submitted by**	**Due date**
Consolidated Project Financial Statements prepared by FECO and audited by Audit Service Center of CNAO	FECO PMO	June 30 of each calendar year

Disbursements

25. Three disbursement methods are available to the project: advance, reimbursement, direct payment. Supporting documents required for Bank disbursement under different disbursement methods will be documented in the Disbursement Letter issued by the Bank.

26. The World Bank GEF grant would be disbursed against eligible expenditures (taxes inclusive) as in the following table:

Category	**Amount of the Grant Allocated (expressed in USD)**	**Percentage of Expenditures to be financed (inclusive of Taxes)**

(1) Sub-Grants under Parts 1 and 2 of the Project	12,050,000	100% of amount disbursed
(2) Goods, non-consulting services, consultants' services, Training and Incremental Operating Costs under Parts 1, 2, 3 and 4 of the Project	12,200,000	100%
TOTAL AMOUNT	24,250,000	

27. The project financing plan includes a "borrower" contribution of US$42.97 million representing estimated in-kind funding from the national and local governments and from the beneficiary enterprises. Specifically, for component 1, this represents the difference between the project's grant contribution and the full costs related to the investment for the participating enterprises. For component 2, this represents the difference between the project's grant contribution and the full costs related to the investment for the demonstration enterprises for closed-loop systems, and incremental operating costs for the duration of the project for waste water treatment demonstrations. For component 3, the bulk of the estimated cofinancing represents nation-wide expansion of RIFA control training by the Ministry of Agriculture, which is a separate and additional activity not directly covered by the project. Finally, also included for components 3 and 4 are estimates for in-kind contributions to various technical and project management activities.

28. *Retroactive financing*. Withdrawals up to an aggregate amount not to exceed US$2,000,000 may be made for payments made prior to this date but on or after 1 July 2016, for eligible expenditures.

29. *Performance-Based Disbursement Mechanism for Sub-grant.* For the sub-grant, the GEF grant will be disbursed to the selected implementing entities according to the signed sub-grant agreements. The following financing principles and measures should be followed by relevant parties to ensure that robust internal control systems are in place to make sure the project funds are used for the intended purpose effectively and economically.

(a) Eligibility of Expenditures: GEF financing would follow the financing principles of the Bank's Investment Project Financing (IPF) lending instrument which finances project expenditures. As such, the Bank's financing through sub-grants is subject to the actual cost incurred by the beneficiary enterprises for the specific tasks. The eligibility of Bank financing shall be clearly defined in the Grant Agreement and sub-grant agreements.
(b) Amount of Financing: The Bank's task team shall review and provide no objection to the detailed cost estimate proposed by the beneficiaries and agree a pre-determined financing ceiling of the sub-grant amount. The Bank will finance actual expenditures up to the sub-grant ceiling. The Bank's financing through sub-grants cannot be more than the actual incremental expenditures incurred for the sub-grant tasks.
(c) Expenditure reporting: Statement of Expenditures (SOE) need to be provided by the sub-grant implementing entities for the provincial PMOs' review while requesting payments from the OAs or Designated Accounts to ensure the cumulative expenditures incurred are more than or equal to the sub-grant amount disbursed by the Bank.

(d) Verification mechanism: The provincial PMOs or a contracted third party independent verification entity, as well as the Bank, if needed, shall verify the outputs by milestones and the cumulative actual expenditures incurred. The grant disbursement will be based on verification certificates issued by the provincial PMOs. If the sub-grant amount already received by the implementing entities is found to exceed the actual cost incurred, the over withdrawn amount should be refunded to the Designated Account or the Bank.
(e) FM arrangements: FM arrangements shall follow the principle of efficiency and effectiveness. The sub-grant related FM function including project accounting and financial reporting shall be centralized at the PMOs. Meanwhile, the sub-grant beneficiaries will be required to maintain specific memorandum accounting records for the agreed GEF financing and reconcile with the PMOs. The sub-grant implementing entities will also keep all original documents such as contracts, invoices, and the verification reports.
(f) Disbursement arrangement: Payment terms by milestones shall be worked out from technical and financial aspects and agreed with the relevant PMOs and beneficiary enterprises.

30. *Sub-grant agreement:* The PMOs shall sign sub-grant agreements with the sub-grant implementing entities to specify: (a) the scope or TOR for the work, as well as the expected output by milestones; (b) total financing and source of financing for each activity; (c) the implementation schedule; (d) technical requirements; (e) supervision; (f) milestones, verification; (g) payment terms; (h) final acceptance; (i) anti-corruption requirements; (j) non-compliance penalties; (k) FM requirements; (l) procurement requirements if needed; etc. Refund of grant financing from the PMOs to Designated Account or the Bank will be required in case of non-compliance. The sub-grant agreements need to be acceptable to the Bank before signing.

31. *Supervision Plan.* The supervision approach for this project is based on its FM risk rating, which will be evaluated on a regular basis by the FMS in line with the Financial Management Sector Board's FM Manual and in consultation with relevant task team leader. The initial FM supervision will focus on financial staff training and compliance with the Bank's FM and disbursement related requirements, as well as the quality and timeliness of project accounting and financial reporting.

Procurement

32. The procurement capacity assessment concluded that the overall procurement risk is Moderate. The three PMOs housed respectively in FECO, Guangdong and Hubei have adequate experience and capacity to carry out procurement with FECO as the national implementing agency under the Ministry of Environmental Protection in overseeing all procurement activities under the project. However, the designated procurement officers in the two provincial PMOs have no Bank's project experience. Based on FECO's past experience in Bank's financed projects, there may be some key risks, which include: (a) possible misunderstanding between the PMOs' project team, the bid evaluators, and the Bank which could lead to delays in processing procurement and non-compliance with Bank's procurement policies and procedures, and (b) weak contract management capacity of the project team. The following measures have been agreed to further strengthen procurement and contract management capacity of the three PMOs' project team and to mitigate potential procurement risks:

(a) The three PMOs have designated a full-time qualified procurement staff to carry out the procurement activities.
(b) The staff of the three PMOs have attended and will attend workshops on procurement procedures for goods, non-consulting services, and consulting services and contract management for Bank-financed projects,
(c) The Bank will continue to provide advice and guidance on all procurement related issues, and training to the three PMOs throughout the project implementation.
(d) The project will hire technical experts to provide technical support to the three PMOs for a smooth project implementation.

33. Project procurement will be carried out in accordance with World Bank's Guidelines: Procurement of Goods, Works and Non-Consulting Services under IBRD Loans and IDA Credits and Grants by World Bank Borrowers dated January 2011 (revised July 2014); Guidelines: Selection and Employment of Consultants Services under IBRD Loans and IDA Credits and Grants by World Bank Borrowers dated January 2011 (revised July 2014); and the provisions stipulated in the Grant Agreement.

34. Procurement Plan. FECO has developed an initial Procurement Plan for the entire period of project implementation. It is available in the project's database and at the Bank's external website. The Procurement Plan will be updated, reviewed and agreed with the Bank annually, or as required, to reflect project implementation needs.

35. Component 1 PFOS production reduction and Component 2 PFOS use reduction: The funds will be mostly channeled to the selected beneficiary enterprises through the sub-grant agreements between respective PMOs and the beneficiaries. The sub-grants will be used as incremental expenditures to provide incentives to support them to complete their activities in each component. Goods, non-consulting services and consulting services under the sub-grant agreements for these two components will not be included in the procurement plan, and will be procured in accordance with procedures and arrangements acceptable to the Bank, including those set out in the PIM, i.e., the beneficiary enterprises shall procure goods, non-consulting services and consulting services by comparing quotations, performance and quality from different vendors in the market with due attention to economy and efficiency. In addition, some consulting services (component 1) and goods (component 2) will be procured by FECO and are included in the procurement plan.

36. Component 3 Policy and technical assistance and Component 4 Project management: Goods, non-consulting service and consulting services required at national and provincial level as specified in the procurement plan will be procured by FECO and by the two PMOs respectively. All these activities shall be packaged as possible into contracts/lots and will be adequately detailed in the procurement plan.

37. Procurement and Selection Methods and Prior Review Thresholds. The table below indicates the procurement and selection methods and prior review thresholds for goods, non-consulting services, and consulting services to be procured by the three PMOs under the project.

38. Single Source Selection. A total of US$3.1 million would be required for services to carry out research and test non-PFOS-based alternative foam products' safety and reliability, demonstrate the application of alternatives, maintain a PFOS tracking system during project period and carry out research and demonstration of non-PFOS-based alternatives in selected

training facilities in the firefighting foam sector. These services would be directly contracted to CCFP since it has unique mandate, expertise and authority to control and assess the quality and authorize the commercialization of products and technologies in the Chinese firefighting foam sector. CCFP is an MPS affiliated institution and has a unique role as a policy advisor to MPS and other authorities and has unique ability to scale-up the implementation of new technologies and non-PFOS alternative applications in China. Contract implementation for this assignment that will have a duration of four years will be overseen by the FECO PMO, and the Bank's standard consulting contract terms and conditions will apply.

39. Single Source Selection. A total of US$1.98 million would be contracted to NATESC to carry out demonstration of a two-phase treatment method to control red imported fire ants, over four years in 5 provinces. In support of this demonstration, the contract with NATESC will also include training and dissemination of experiences; development of policies and strategies to phase out PFOS for RIFA control; technical guidelines for RIFA control; and laboratory and field experiment to screen alternative pesticides. NATESC has responsibility for domestic plant quarantine work, which includes RIFA outbreak monitoring, prevention and control. NATESC is the authority in this field and has unique and extensive experience and expertise with national level inter-provincial monitoring, prevention and supervision, thereby ensuring that project activities and lessons learned would be sustained and replicated after project closure. Contract implementation for this assignment of a four-year duration will be overseen by the FECO PMO, and the Bank's standard consulting contract terms and conditions will apply.

40. Post Review. Bank 's procurement team and /or external auditors will conduct field visits for post review of procurement actions every 12 months. The post review sampling ratio will be at least one out of 10 contracts. This ratio will be adjusted periodically during project implementation based on the performance of FECO.

41. Advance Contracting and Retroactive Financing. Retroactive financing will be permitted for the project within the limits specified in the Grant Agreement. It has been agreed during project negotiation that retroactive financing of up to US$2 million would be available for eligible expenditures incurred on and after 1 July, 2016, mainly to support Incremental Operating Costs (IOC) and some consultancies that are specified in the procurement plan approved by the World Bank. FECO's Procurement Plan sets forth those contracts which are expected to be signed in advance of grant signing together with the relevant Bank review procedures. Only payments made under such contracts procured in accordance with the applicable Bank procurement/consultant selection procedures will be eligible for reimbursement by the Bank. TORs of all the prior review contracts and some priority consultancies will be reviewed by the Bank.

Expenditure Category	**Contract Value (US$)**	**Procurement Method**	**Bank Prior Review**
Goods/IT Systems and Non-Consulting Services	≥ 10 million	ICB	All contracts >= US$ 4 million
	>=500,000 and < 10 million	NCB Remarks: Where goods are not normally available within China, the method	

Expenditure Category	Contract Value (US$)	Procurement Method	Bank Prior Review
		of procurement will be ICB even if the contract value is less than US$10 million.	
	< 500,000	Shopping	None
	n.a.	DC	All DC contracts>= US$4 million
Consultants	≥ 300,000	QCBS, QBS, LCS, FBS	Firms: All contracts ≥ US$ 2 million; Firms: All SSS contracts >= US$ 1 million; Individual Consultant: >= US$ 400,000; SSS for individual consultant: ≥ US$400,000
	< 300,000	QCBS, QBS, LCS, FBS, CQS	
	n.a.	SSS	
	n.a.	IC	

Notes: ICB: International Competitive Bidding
NCB: National Competitive Bidding
DC: Direct Contracting
QCBS: Quality- and Cost-Based Selection
QBS: Quality-Based Selection
LCS: Least Cost Selection
FBS: Fixed Budget Selection
CQS: Selection Based on the Consultants' Qualifications
SSS: Single Source Selection
IC: Individual Consultant selection procedure
n.a.: Not Applicable

Environmental and Social (including safeguards)

Environment Safeguards

42. The project has overall positive environmental impacts as it supports phasing out or reducing the PFOS and replacing with less toxic and persistent chemicals in China. To manage its impacts and risks, an ESMF has been developed which has two parts. Part I is Environmental Management Framework (EMF) and Part II is the Social Management Framework. The ESMF has been disclosed locally in March and July 2016 and at the World Bank's InfoShop in September 2016. Under the EMF, selection criteria for entities eligible for the project's support are set out.

43. The EMF is constructed on different scenarios that are considered possible under this project and divided into two groups. One group is sectors that are composed of enterprises, namely, PFOS producers, firefighting foam manufacturers and users in metal plating. The project will support PFOS producers to convert to other products, retrofit of existing processes to reduce the use of PFOS containing chemicals or shut-down of facilities. The other group is non-enterprise entities, namely firefighting departments or training base and pesticide use in agriculture that replace the PFOS containing products with alternatives.

44. All eligible enterprises and entities will need to carry out an Environmental Impact Assessment (EIA) for their planned pilot activities, except those to be closed and simple switch to alternative chemicals. For those facilities to be closed, an Environmental Site Assessment (ESA) is required. ESA is also called liability audit by the Bank and will inevitably include a review of the operation on-site before the closure. Due to limited resources available, the project will not support site remediation, but only the site assessment of the closed enterprises and dismantling of equipment.

45. For those sub-projects that only involve simple substitution of process chemicals, e.g. switching to non-PFOS CMS in metal plating, no EIA is warranted. In such cases, the enterprise will need to conduct an Environmental Audit. The audit will evaluate the facility or operation's compliance with applicable regulations, criteria and standards, including relevant WBG Environmental, Health and Safety (EHS) Guidelines.

46. All the above assessments and audits will result in an Environmental Management Plan (EMP). It will include mitigation measures and supervising and monitoring arrangement to address issues/gaps identified in the various assessments and audits. The EMF clarifies that the enterprises and entities concerned are responsible for the preparation of these above instruments which serve as one of the pre-conditions for the GEF grant support.

47. The EMF also specifies the review and supervision mechanism as well as responsibility in environmental management of major parties involved. The Foreign Economic Cooperation Office (FECO) of the Ministry of Environmental Protection (MEP) will be the national-level PMO with overall responsibility for the EMF implementation, review and supervision. The Bank team will review all category A sub-projects and the first subproject in each sector at least. The beneficiary enterprises and local implementing units (firefighting and agriculture) are responsible for implementing their EMPs and the PMP, respectively.

48. The annexes of the EMF include detailed Term of reference (ToRs) and table of content for EIA, EMP, environmental audit and ESA. For PFOS-free insecticide use in agriculture sector, a Pest Management Plan (PMP) was developed as one annex of the EMF with its main content explained in the main text of the PAD. All PMOs are national or provincial environmental agencies thus experienced in managing environmental impacts. They all have assigned staff in charge of safeguard and performed well so far.

49. The EMF describes succinctly the sectors mentioned above, their main processes and technologies, major pollution and environmental risks associated. Typical for chemical intensive industries, these include air emissions of acidic and alkali chemicals and flue gas from boilers, water effluent high in non-biodegradable substances or heavy metals, inorganic sludge and solid wastes including hazardous wastes, and their disposal off-site, as illustrated by the environmental audit for Hengxin Chemical Company Ltd, the pilot under consideration during preparation, though participation is not confirmed.

50. Since the project also aims at promoting cleaner production (CP) as BAT/BEP for existing production, a CP audit was conducted as part of the environmental audit for Hengxin Company. The results show that the factory is generally compliant with environmental

requirements and criteria and meets concentration discharge standards, but exceeds allocated total pollution load for some parameters. Mitigation measures are included in its EMP to tackle the issues identified. This exercise offers insight and experience for the CP guidance development under component 3. An EIA will be prepared for Hengxin Company as soon as project support to Hengxin is confirmed and subproject details are identified.

Social Safeguards

51. The project focuses on demonstration, replacement, reduction and phase-out in enterprises in the PFOS production, metal plating, pesticide and firefighting sectors on. It will have positive social benefits as it will reduce the negative health impacts associated with PFOS production by producing non-PFOS alternatives. By project appraisal, one pilot enterprise was under consideration, although its participation and details of investment plans not yet confirmed, i.e. Hubei Hengxin Chemical Company Limited (HHCC). According to social assessment, this company was established in 2004 and occupies less than two hectares in Yingcheng City. It is currently the largest PFOS producer in China. This enterprise would phase out its PFOS production and upgrade its capacity for other less toxic products. This is anticipated to have limited negative social impacts because it is planned that each affected employee will be reassigned jobs within this company.

52. However, given that future project enterprises may close partial or all PFOS production, there may be limited adverse social impacts related to involuntary resettlement and job changes or losses of a small number of workers as the project activities are carried out. During project implementation, a limited number of project enterprises may need to reduce production or some few enterprises may be relocated in line with local urban plans. To address potential relocation or partial closure with possible involuntary resettlement, a resettlement policy framework (RPF) and employee resettlement framework as part of the environmental and social management framework (ESMF) have been prepared based on surveys of some sample project enterprises and interviews with relevant stakeholders.

53. To address potential job changes or losses which is foreseeable for a small number of workers of project enterprises, beneficiary enterprises will provide training, new job assignments within the same group of the company, and other kinds of assistance for affected workers. Chinese labor laws and regulations will be followed to ensure appropriate compensation and livelihood restoration to affected workers. The ESMF states that local Chinese labor laws and regulations, and World Bank safeguards policies should be followed to ensure appropriate compensation and livelihood restoration for affected people.

54. In case of 20 or more employees will be laid off at one time by a project enterprise, according to the Chinese government labor regulation, a full employee resettlement plan should be prepared by the enterprise and reported to the local labor authorities. The plan should be submitted to the Bank team for prior review before actual layoff of staff of the related enterprise. Those laying off less than 20 employees should follow the Chinese government labor regulations, and the employee resettlement plan to be prepared should also be subject to prior review by FECO and the World Bank and can be covered in the environment assessment report under OP 4.01. A social screening will be done for every subproject to assess social impacts and risks. A comprehensive social assessment will be done for every subproject which has negative

social impacts and risks. A social assessment report will be done as required accordingly through hiring experienced professionals. In case, the project involves any closure or relocation of the existing facilities, social impacts on livelihoods and employees' job security occur, specific social management instruments will be prepared to fully address such issues on specific subproject basis.

55. To mitigate environmental and social risks, implementation of the environmental and Social Management Framework (ESMF) which includes Resettlement Policy Framework (RPF) and employee resettlement plan framework will be closely supervised by FECO and the local project owners and an external monitoring team during project implementation. This work will be funded through counterpart funds. Further, the Bank team will periodically carry out field supervision and provide safeguard training and guidance to the PMOs. Such supervision and safeguards training will be funded through the Bank's supervision budget. More details on preparation and implementation are as follows:

Preparation Phase

(a) *Subproject Screening.* FECO is responsible for project screening. The enterprise will submit the application materials to FECO, which will in turn review materials. It will exclude from financing any proposed subproject that includes, or is linked or connected to any production facility or manufacturer included in the Exclusion List.

(b) *Documentation of EA, due diligence report or resettlement action plan for land taking.* The enterprise is responsible for preparing safeguards documentation (e.g. EA/EMP, Resettlement Action Plan (RAP) or due diligence report). It will be required to submit to FECO a document package consisting of items outlined in the ESMF/RPF.

(c) *Public Consultation and Disclosure.* The enterprise is responsible for conducting public consultation(s). These responsibilities include: (i) public notification, (ii) conducting the consultation and (iii) recording the significant findings, conclusions, recommendations and next steps. Public disclosure provides affected groups or individuals the opportunity to examine the safeguards documents so that they can review the mitigating measures agreed upon and the responsibilities for implementing them. Such final safeguards documents will be locally disclosed. Details of the documentation required for the public consultation are presented in the annex of the ESMF.

(d) *Grievance Mechanism.* In order to ensure that consultation, disclosure, and community engagement continues throughout project implementation, the enterprises will establish a grievance mechanism. This should allow the enterprises to receive and facilitate resolution of concerns and grievance about the sub-projects environmental performance, land taking and involuntary resettlement as well as end of employment concerns raised by the affected communities or individuals.

(e) *Review and Approval of Subprojects.* FECO will review the document package submitted by enterprise to ensure it is consistent in terms of environmental and social

issues, mitigating measures, monitoring requirements and institutional responsibilities for mitigation and monitoring. If necessary, FECO will request additional supplementary information from the enterprise to ensure that the World Bank EA and involuntary resettlement procedures are also followed.

(f) *Related Conditions and Responsibilities.* FECO will ensure that an appropriate clause is included in the enterprise's contract obligating the enterprises to implement the mitigation, monitoring, and reporting measures specified in the EMP, ESMF (RPF or RAP) and to strictly follow the procedures according to related Chinese laws and regulations.

56. It is the responsibility of the enterprises to ensure that relevant tender documents and contracts include requirements put forward in the EMP, ESMF/RPF or RAP. During subproject implementation, FECO has the right to check the documents and contracts to verify that this condition has been satisfied.

Implementation Phase

57. *Monitoring and Reporting.* FECO will work with local environmental authorities and project enterprise to ensure that sub-project implementation meets the requirements of all specified safeguards instruments (EMP, ESMF/ RPF, RAP in some cases). FECO will require each enterprise to report on the implementation of its safeguards instruments, hiring experienced consultant as needed. FECO will send a monitoring and progress report on the safeguards instruments regularly to the Bank.

58. *Project Enterprises*. The project enterprises will carefully document monitoring results in accordance with the Monitoring Plan included in the safeguards instrument and identify any necessary corrective or preventive actions taken during the monitoring period, as well as the results/outcome of similar actions that may have been taken in the previous reporting period.

59. *Institutional Arrangements.* FECO will designate staff to manage environmental risk and assure that procedures specified in the ESMF (combined with EMF and SMF) are properly followed during implementation. In addition, qualified Chinese environmental and social consultants will be contracted to support FECO to perform the tasks required under the EMF and SMF/RPF in the identification and management of environmental and social risk in project evaluation and implementation.

60. *Public Consultations and Information Disclosure.* Public consultation will be conducted in accordance with the framework after enterprises and their specific activities are identified during project implementation. The SMF including the RPF was locally disclosed in August 2016 through announcements published in the local newspaper and on the internet websites of FECO. The SMF was sent to the Bank's InfoShop for disclosure in September 2016.

Monitoring and Evaluation

61. *Reporting requirements.* The reporting requirement for this project can be categorized into three levels: (a) overall program reporting level; (b) overall project reporting level; (c) sub-project reporting level.

Annex 4: Implementation Support Plan

CHINA: Reduction and Phase-out of PFOS in Priority Sectors

Strategy and Plan for Implementation Support

1. The objective of the implementation support plan is to ensure: (a) the objectives of the project are satisfactorily achieved; (b) implementation of all project activities follows agreed procedures and complies with all fiduciary and safeguards requirements; and (c) identified risks are timely and adequately mitigated. While most of the project risks are either low or moderate, the overall project risk is rated as substantial due to the unintended environmental impacts and involvement of multiple stakeholders. Hence, the focus of Bank's implementation support will be on the implementation support and managing of unintended environmental impacts.

2. *Technical design and acceptability of alternatives by industry:* Because the project will provide incentives to introduce PFOS alternatives that are new in China, there is a substantial risk related to the acceptability of alternatives by industry, potentially due to concerns about efficacy and cost effectiveness. As such, industry may continue using PFOS for non-acceptable use after March 2019. The risk will be mitigated through carefully designed communication strategy, provision of support for development and screening of PFOS alternatives, introducing incentives for demonstration enterprises, and set up and implementation of a strong monitoring system with FECO and relevant regulatory authorities to ensure that PFOS is produced and used for acceptable uses only.

3. *Environmental impacts:* This risk will be mitigated through strong emphasis on screening of potential alternatives for POPs characteristics, as well as strengthening capacities for such screening.

4. *Stakeholders:* The stakeholder risk related to the sectoral coverage of diverse and large number of enterprises will be mitigated by setting up clear demonstration enterprise selection criteria, including analysis of their financial capacity, as well as working with industry associations and pilot province environmental / sector authorities for delivery of assistance. The three PMOs in FECO, Guangdong and Hubei provinces have recruited qualified staff and hands-on training will be provided by the Bank team.

5. The tables below summarize the implementation support needed during the different stages of the project, and the respective resources.

Time	Focus	Skills Needed	Resource Estimate
First 12 months	Task management	TTL and Co-TTL	10 SWs
	Technical supervision and support	POPs alternatives specialist; policy specialist	8 SWs
	Environmental management and supervision	Environmental specialist	5 SWs
	Social safeguards supervision	Social development	2 SWs

		specialist	
	Procurement supervision and training	Procurement specialist	4 SWs
	FM supervision and training	FM specialist	4 SWs
12-60 months	Project management	TTL and Co-TTL	8 SWs
	Technical supervision and support	POPs alternatives specialist; policy specialist	6 SWs
	Environmental management and supervision	Environmental specialist	3 SWs
	Social safeguards supervision	Social development specialist	2 SWs
	M&E Specialist	M&E	1 SW
	Economic and Financial analysis	Economist / Financial Analyst	1 SW
	Procurement review, supervision and training	Procurement specialist	2 SWs
	FM supervision and training	FM specialist	2 SWs

Skills Mix Required

Skills Needed	**Number of Staff Weeks each Year**	**Number of Trips**	**Comments**
TTL/Environmental specialist	5 SWs	2	Washington based
Co-TTL/ Environmental economist	5 SWs	2	Country office based
Sector phaseout specialist	4 SWs	2	Washington based
Procurement specialist	2 SWs	2	Country office based
FM specialist	2 SWs	1	Country office based
Environmental specialist	3 SWs	2	Country office based
Social development specialist	2 SWs	2	Country office based
M&E specialist	1 SWs	1	Local Consultant
Economist	1 SWs	1	Local Consultant
Financial analyst	1 SWs	1	Local Consultant

Annex 5: Economic and Financial Analysis

Economic analysis

1. PFOS is ubiquitous and toxic. Reduction of its production and use will lead to reduced occupational exposure and releases to the environment, and therefore reduced risks of harmful effects on the environment and on human health, directly and through the food chain. Currently available alternatives to PFOS are not necessarily economically and technically equivalent to PFOS. To switch to alternatives can mean higher costs to enterprises or compromised functionality. C6-telomer based fluorosurfactants, for example, are reported to be 15-20 percent higher priced than PFOS based surfactants. The project seeks to limit costs to PFOS reduction by introducing and promoting locally available alternatives where possible and locally appropriate best practices. The total cost of PFOS phase-out is estimated at US$200-300 million, of which the GEF would contribute US$24 million for this project.

2. Incremental costs also occur with the incorporation of PFOS into regulation covering the different stages of the life-cycle of PFOS; with costs in particular related to enforcement. The GEF funds will be spent to spearhead the substitution of alternatives and demonstrate BAT/BEP with due attention paid to capacity building activities, while the private/industrial sector and government will bear most of the incremental costs.

3. Implementation of the project would help reduce direct exposure to PFOS of at least 7.2 million people currently living and working in the PFOSF production areas or engaged in spraying PFOS-based pesticides for RIFA control (and over 1600 employees of participating enterprises), improve food safety and quality and their overall living environment. More people will benefit from activities that will reduce PFOS use in various industrial applications that will be selected during project implementation. Monetizing direct impacts on human health from PFOS exposure is a complex task that would require extensive research and epidemiological evidence that is not available to the client or the project team at this point.

4. A study that investigated the impact of PFOS-containing firefighting foam during the May 2001 fire in a storage depot for plastic crates in Dusseldorf (Weber et al., 2010) examined the soil, groundwater and vegetable /fruit contamination levels at the site. The preliminary risk assessment of top soil, fruits and vegetables contaminated through the groundwater used for irrigation found that there would be a risk if a larger quantity of fruits and vegetables were consumed, based on tolerable daily intake (TDI) over lifetime. The study also concluded that contamination of groundwater with PFCs was evidenced within a distance of up to 400m from the former storage depot, and the level of contamination was as high as 89,000 ng/l and, thus, drastically exceeded the precautionary value of 100 ng/l for drinking water.

5. While no epidemiological data were collected as part of that study, there are currently a number of investigations under way, results of which might provide in the future enough information to monetize human health impacts due to project interventions. For example, currently, a large epidemiological study on human contamination and effects is ongoing near a factory where PFC wastes have been

disposed of in an area where 69,000 inhabitants have been exposed to PFC-contaminated drinking water.

6. Other benefits of reduced exposure to PFOS, as evidenced by studies in USA, include secured earnings for farmers and fishermen. Detailed investigations have been ongoing for more than a decade at sites where the former main producers of PFOS disposed of PFC-containing residues. The groundwater in these landfill sites is contaminated and many drinking wells have been contaminated (Oliaei et al., 2006, Vieira et al., 2008). Approximately 70,000 people, residing near PFC waste disposal sites in Minnesota, are affected by PFOS contamination in their drinking water. The water and sediments of the Mississippi River, downstream of a factory, are polluted with migrating PFC waste in underground water and PFC-containing wastewater discharged partly from landfill leachates. Most fish in this area have been found to be highly contaminated with PFOS, resulting in issuance of an advisory to limit fish consumption (Oliaei et al., 2006, 2010).

7. Additional benefits of the project through introducing non-PFOS alternatives in the firefighting sector include the saved cost of remediation of areas exposed to the firefighting foam currently used for training purposes and from fire extinguishing. The Dusseldorf study mentioned above has estimated that cost of remediation of $42m^3$ of AFFF (concentrate of extinguishing foam) used to extinguish fire in the storage depot reaches a minimum of US$12 million. Assuming that just 20 percent of the foam is being used for training or fire extinguishing purposes in China, the remediation cost of the land exposed to PFOS would theoretically reach over US$800 million. This would easily offset the cost of conversion of the entire sector, based on estimates at project preparation.

8. The investment in conversion of production and promotion of alternatives will follow a least cost approach, based on strict control at the source of PFOSF being produced and available to the market only for allowed use under the Stockholm Convention and Chinese regulations, with incentives to the industry to facilitate buy-in and implementation of PFOS phase-out, as an effective way to achieve the Government's policy objective and meeting international treaty commitments.

Financial analysis

9. Change to production and use of non-PFOS chemicals will involve investment in technology research and development, facility reconstruction, equipment purchase etc. One PFOSF producer, Hubei Hengxin Chemical Industry Co., Ltd., is being considered as a pilot for conversion of their production lines to introduce non-PFOS alternatives, to be confirmed during project implementation. Example of financial cost-benefit analysis and estimated investment payback period for the proposed Hubei Hengxin enterprise has therefore been carried out to illustrate the financial impacts of the project.

10. *Costs*:

Investment costs (RMB 87.6 million), of which investment in fixed assets - RMB 67.6 million and working capital - RMB 20 million.

Financing plan - 12.5 percent of aggregate investment (i.e. RMB 10.95 million) is expected to be supported by GEF funding; RMB 46.65 million raised by the company; RMB 30 million - from commercial bank loans.

Operating costs (RMB 67.915 million), of which raw materials are expected to cost RMB 48.126 million, fuel and power - RMB 19.789 million.

Economic life of project (7 years), of which, construction period is 2 years and production period is 5 years.

Depreciation cost of fixed assets - the original value of fixed assets created by the project is estimated at RMB 67.6 million, accounting for 80 percent of fixed investment. Depreciation cost is accrued at a yearly rate of 10 percent by using composite depreciation method.

Maintenance cost - 30 percent of depreciation cost.

Other manufacturing cost - 10 percent of maintenance cost.

Wages and surcharges (RMB 12 million), assuming the total number of employees of 120 and the wage and surcharge of each employee RMB 100,000 per year.

Sales expense - 3 percent of sales amount.

Financial expense - 10 percent of loan amount.

Other management expenses - 3 percent of sales amount.

Tax rate - VAT rate 17 percent, urban maintenance and construction tax rate 7 percent, education surtax rate 3 percent and local education surtax rate 2 percent. Product income tax 25 percent.

Table 5-1 Total Annual Cost of Hubei Hengxin Chemical Industry Co., Ltd.

No.	**Item**	**Amount (RMB 10,000)**	**Remarks**
1	Cost of purchased raw materials and auxiliary materials	4,812.6	
2	Cost of fuel and power	1,978.9	Water, electricity, gas and cooling
3	Manufacturing cost	716	
(1)	Depreciation cost	540	10% of fixed assets
(2)	Maintenance cost	160	30% of depreciation cost
(3)	Other manufacturing cost	16	10% of maintenance cost
4	Wage and surcharge	1,200	
5	Sales expense	400	3% of sales amount
6	Financial expense	300	10% of loan amount
7	Management expense	400	3% of sales amount
8	(1-8) total cost	9,807.5	
Where	Variable cost	7,191.5	
	Fixed cost	2,616	

9	Operating cost	9,267.5	

11. *Benefits:* It is assumed that of 50 t of non-PFOS alternative produced, 30 tons of perfluorodecalin sulfuryl will be sold and the remaining 20 tons will be used to prepare perfluorodecalin sulfonic acid potassium, perfluorodecalin tetraethylamine, perfluorodecalin surfactant, etc. According to current market price, the annual output value of the project can reach RMB127.37 million.

12. *Cost and benefit summary*:

Table 5-2 Cost and Benefit summary

No.	**Item**	**Unit**	**Amount**	**Remarks**
1.1	Aggregate investment of the project	RMB 10,000	8760	
1.2	Investment in construction	RMB 10,000	6760	Among which RMB 10.95 million is obtained from funding plan.
1.3	Interest of loan during construction period	RMB 10,000	300	
1.4	Working fund	RMB 10,000	2000	
2	Annual average sales (operating) revenue	RMB 10,000	12737	Reaching 100% of design capacity
3	Annual average sales tax	RMB 10,000	1010.74	Reaching 100% of design capacity
4	Annual average cost	RMB 10,000	9807.5	Reaching 100% of design capacity
5	Annual average profit	RMB 10,000	1797.47	Reaching 100% of design capacity
6	Annual average income tax	RMB 10,000	449.37	Reaching 100% of design capacity
7	***Annual average profit after tax***	***RMB 10,000***	***1348.10***	***Reaching 100% of design capacity***

13. It can be seen from the above analysis that by introducing non-PFOS alternatives in production and assuming 100 percent of design capacity of Hubei Hengxin Chemical Industry Co., Ltd., its output value will reach RMB 127.37 million, with annual average profit reaching RMB 18 million.

14. Based on the data from the financial cost benefit analysis of Hubei Hengxin Chemical Industry Co., Ltd., the preliminary analysis of net benefit stream for seven PFOSF manufacturers that were still active in 2014 is summarized in table 5-3 below.

Table 5-3 Cost and Benefit Analysis Summary of Remaining PFOSF Manufacturers

Item	Unit	Hubei Youshida Technology Co., Ltd.	Xiaochang Xiangshun Chemical Co., Ltd.	Yingcheng Sanwei Chemical Co., Ltd.	Wuhan Chemical Industry Institute Co., Ltd.	Wuhan Defu Economic Development Co., Ltd.	Hubei Hengxin Chemical Industry Co., Ltd.	Shaowu Huafu New Material Development Co., Ltd.	Total	Remarks
Aggregate investment	RMB 10,000	2459	906	647	2082	777	9060	1683	17614	
Investment in construction	RMB 10,000	1900	700	500	1609	600	6760	1300	13369	
Where: self-raised fund	RMB 10,000	753	277	199	639	233	2628	510	5237	
Bank loan	RMB 10,000	840	310	220	710	270	3000	580	5930	
GEF Grant	RMB 10,000	307	113	81	260	97	1133	210	2202	12.5% of aggregate investment
Interest of loan during construction period	RMB 10,000	84	31	22	71	27	300	58	593	10% of loan amount
Working capital	RMB 10,000	475	175	125	402	150	2000	325	3652	
Annual average sales (operating) revenue	RMB 10,000	5500	1200	900	2800	1200	12737	2300	26637	Reaching 100% of design capacity (based on respective product price)
Annual average sales tax	RMB 10,000	440	96	72	224	96	1019	184	2131	Reaching 100% of design capacity
Annual average	RMB	4515	924	712	2265	942	9808	1851	21017	Reaching 100%

Item	Unit	Hubei Youshida Technology Co., Ltd.	Xiaochang Xiangshun Chemical Co., Ltd.	Yingcheng Sanwei Chemical Co., Ltd.	Wuhan Chemical Industry Institute Co., Ltd.	Wuhan Defu Economic Development Co., Ltd.	Hubei Hengxin Chemical Industry Co., Ltd.	Shaowu Huafu New Material Development Co., Ltd.	Total	Remarks
cost	10,000									of design capacity
Annual average profit	RMB 10,000	545	180	116	311	162	1910	265	3489	Reaching 100% of design capacity (based on the level of respective company)
Annual average income tax	RMB 10,000	136.25	45	29	77.75	40.5	477.51	66.25	872	Reaching 100% of design capacity (tax rate is 25%)
Annual average profit after tax	RMB 10,000	409	135	87	233	122	1433	199	2617	Reaching 100% of design capacity
Return on investment	%	16.6	14.9	13.4	11.2	15.6	15.8	11.8	14.9	After tax
Investment payback period	Year	8.0	8.7	9.4	10.9	8.4	8.3	10.5	8.7	Including construction period
Loan repayment period	Year	4.1	4.3	4.5	5.0	4.2	4.1	4.9	4.3	Including construction period
Proposed product change period	Year	3	3	3	8	3	3	3	3	According to the plan of each manufacturer

15. The above analysis shows that the aggregated investment of RMB 176.14 million in seven PFOSF manufacturing enterprises would generate RMB 266.37 million sales revenue and an annual average profit after tax of approx. RMB 26.17 million. Average investment payback period would be 6.7 years, without funding from GEF grant. With GEF Grant, the payback period is estimated to reach 4.3 years. Thus, it can be concluded that the profitability of PFOS manufacturers before product change is roughly equal to that of PFOS manufacturers after product change. However, product change will positively influence the operation of those manufacturers within 4-5 years.

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