**GEF-7 Project Identification Form (PIF)**

**Project Type:**

**Type of Trust Fund:**



PART I: Project Information

|  |  |  |  |
| --- | --- | --- | --- |
| Project Title: | Facilitating Cleaner and Energy Efficient Phosphate Chemicals Industry in China (PhosChemEE) Project | | |
| Country(ies): | People's Republic of China | GEF Project ID: |  |
| GEF Agency(ies): |  | GEF Agency Project ID: | PIMS 6431 |
| Project Executing Entity(s): | * Ministry of Natural Resources * Ministry of Industry and Information Technology | Submission Date: | 22 Sep 2020 |
| GEF Focal Area(s): |  | Project Duration (Months) | 60 |

1. Indicative Focal/Non-Focal Area Elements

|  |  |  |  |
| --- | --- | --- | --- |
| Programming Directions | Trust Fund | (in $) | |
| GEF Project Financing | Co-financing |
| Promote innovation and technology transfer for sustainable energy breakthroughs for accelerating energy efficiency adoption |  | 7,153,555 | 56,200,000 |
| Promote innovation and technology transfer for sustainable energy breakthroughs for cleantech innovation |  | 1,788,389 | 14,000,000 |
| **Total Project Cost** |  | 8,941,944 | **70,200,000** |

1. Indicative Project Description Summary

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Project Objective: Enabling the extensive application of low carbon and energy efficient technologies in the phosphate chemicals industry in China. | | | | | | |
| Project Components | Type | Project Outcomes | Project Outputs | Trust Fund | (in $) | |
| GEF Project Financing | Co-financing |
| 1. Green and Low-carbon Development and Operation of Phosphate Mines | TA | Improved interest and commitment of the phosphate chemical industry in the green, low carbon and energy efficient operations of the phosphate mining sub-sector in China. | * Formulated, recommended, approved, and enforced policy and institutional frameworks supporting green, energy efficient low carbon development initiatives in phosphate rock (phosrock) mining and refining. * Formulated, recommended, and enforced standards, policies and implementing rules and regulations on the promotion and practice of green, energy efficient, low carbon technologies/techniques, in the development and operations of phosphate mines. * Documented annual evaluation reports on the energy performance and environmental impacts of each demo project and documented and disseminated demo project results[[1]](#footnote-1). * Completed capacity needs assessment in the area of green, energy efficient low carbon technologies applied in phosphate mining and refining, and designed capacity development program to be implemented for the phosrock mines in Weng'an, Guizhou, Jinning, Yunnan, and Mabian and Leibo counties, Sichuan. * Fully conducted and post-evaluated capacity development program on the principles and application of green, energy efficient low carbon technologies/techniques in phosphate mining and refining. * Published and disseminated technical guides and reference documents for the application of energy conserving and energy efficient practices in the phosphate mining sub-sector. * Established the online monitoring, reporting and verification system for energy-saving and GHG emission reduction from the application green, energy efficient low-carbon technologies in the PCI[[2]](#footnote-2). * Published and disseminated publicity information about China's green, energy efficient and low-carbon phosrock mining and refining. | GEFTF | 876,300 | 6,550,000 |
|  | Inv | Enhanced confidence in the feasibility of the application of green, energy efficient low carbon technologies in phosrock mining and refining in China. | * Completed designs and plans of demonstrations of green, energy efficient and low carbon technologies in phosphate mines development and operations including: (a) Improved design for the mining and refining operations in the demo phosrock mines in Weng'an, Mabian, Guizhou, Sichuan[[3]](#footnote-3); (b) Feasibility analyses of the application and operation of green, energy efficient and low carbon phosrock mining and refining systems; and, (c) Implementation plans (including financing arrangements) for each green, energy efficient and low carbon technology application in the demo phosrock mines. * Installed and operational green, energy efficient low carbon technology application demos in phosrock mining and refining in Weng'an, Guizhou, Jinning, Yunnan, and Mabian and Leibo counties, Sichuan. * Approved and financed follow-up plan for the replication of the application of demonstrated green, energy efficient low carbon technologies in phosrock mining and refining in other localities. | GEFTF | 1,627,400 | 12,170,00 |
| 2. Green and Low-Carbon Design and Operation of Phosphate Chemicals Production Facilities | TA | Established a green and low-carbon development model for phosphorus chemicals | * Formulated, recommended, approved, and enforced policy and institutional frameworks supporting green, energy efficient low carbon technology applications in phosphate chemicals production. * Formulated, recommended, and enforced standards, policies and implementing rules and regulations on the promotion and practice of green, energy efficient, low carbon technologies/techniques, in phosphate chemicals production. * Documented annual evaluation reports on the energy performance and environmental impacts of each demo project and documented and disseminated demo project results based on the MRV system established under Component 1. * Completed capacity needs assessment in the area of green, energy efficient low carbon technologies applied in phosphate chemicals production, and designed capacity development program to be implemented for the phosphate chemical companies in Yunnan, Guizhou, Sichuan, and Hubei. * Fully conducted and post-evaluated capacity development program on the principles and application of green, energy efficient low carbon technologies/techniques in phosphate chemicals production. * Published and disseminated technical guides and reference documents for the application of energy conserving and energy efficient practices in the phosphate chemicals production sub-sector. * Completed market analysis report on the international trade trends for phosrock and phosphate chemicals, and the indirect carbon emission and ecological impacts in the international trading of these products. * Published and disseminated publicity information about China's green, energy efficient and low-carbon phosphate chemicals manufacturing. | GEFTF | 938,900 | 7,020,000 |
|  | Inv | Enhanced confidence in the feasibility of the application of green, energy efficient low carbon technologies in phosphate chemicals production in China. | * Designed and approved pilot financing scheme for small and medium enterprises (SMEs) that manufacture phosphate chemicals. * Completed designs and plans of demonstrations of green, energy efficient low carbon technologies in phosphate chemicals production including: (a) Improved design for cleaner production demos[[4]](#footnote-4); (2) Feasibility analyses of the application and operation of green, energy efficient and low carbon phosphate chemical production systems; and, (3) Implementation plans (including financing arrangements) for each green, energy efficient and low carbon technology application in the demo phosphate chemical companies. * Installed and operational green, energy efficient low carbon technology application demos in phosphate chemicals production. * Operational pilot financing scheme for phosphate chemicals SMEs in 2 to 3 regions. * Approved and financed follow-up plan for the replication of the application of demonstrated green, energy efficient low carbon technologies in phosphate chemicals production in other localities. | GEFTF | 2,816,700 | 21,060,0000 |
| 3.Green and Low Carbon Design and Operation of Waste Management Systems in the Phosphate Chemicals Industry | TA | Enhanced commitment of the phosphate chemical industry in green and low carbon waste management. | * Completed research reports on: (1) annual volume of waste production in phosrock mining and refining, and in phosphate chemicals production in China; (2) green and low carbon waste management systems for waste recycling and reuse developed and implemented in other countries and their energy utilization performances; and, (3) potential commercial markets for processed waste, e.g., phosphogypsum. * Formulated and recommended schemes, standards, policies/regulations on the application of green and low carbon waste management technologies in the phosphate chemicals industry in China. * Documented annual evaluation reports on the energy performance and environmental impacts of each demo based on the MRV system developed under Component 1. * Completed capacity needs assessment in the area of green and low carbon technologies applied in waste management in the phosphate chemicals industry, and designed capacity development program to be implemented. * Fully conducted and post-evaluated capacity development program on the principles and application of green and low carbon waste management technologies/techniques in the phosphate chemicals industry. * Published and disseminated technical guides and reference documents for the application of green and low carbon technologies/techniques in waste management in the phosphate chemicals industry.   Published and disseminated publicity information about China's green and low-carbon waste management in the phosphate chemicals industry. | GEFTF | 804,844 | 60,200,000 |
| Inv | Increased confidence in the feasibility of the application of green and low carbon technologies in the management of waste in the phosphate chemicals Industry in China. | * Completed designs and plans of demonstrations of the application of green and low carbon technologies/techniques in waste management in the phosphate chemicals industry, including: (a) improved phosrock mining tailings recycling and reuse; and, (b) energy efficient processing of phosphogypsum and marketing of the gypsum products. * Installed and operational green and low carbon waste management technology application demos in the phosphate chemicals industry. * Approved and financed follow-up plan for the replication of the application of demonstrated green, low carbon waste management technologies in the phosphate chemicals industry in other localities. | GEFTF | 1,877,800 | 14,040,000 |
| Subtotal |  |  |  | GEFTF | 8,941,944 | 66,860,000 |
| Project Management Cost (PMC) | | | | | 447,097 | 3,340,000 |
| **Total Project Cost** | | | | GEFTF | 9,389,041 | 70,200,000 |

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

1. Indicative Sources of Co-financing for the Project *(by name and by type, if available)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sources of Co-financing** | **Name of Co-financier** | **Type of Co-financing** | **Investment**  **Mobilized** | **Amount ($)** |
| Recipient Country Government | Ministry of Industry and Information Technology | Grant | Investment mobilized | 2,300,000 |
| In-kind | Recurrent expenses | 700,000 |
| Ministry of Natural Resources | Grant | Investment mobilized | 1,500,000 |
| In-kind | Recurrent expenses | 500,000 |
| Local people’s government at project demonstration and replication area, including Sichuan, Yunnan, Guizhou, etc. | Grant | Investment mobilized | 8,000,000 |
| In-kind | Recurrent expenses | 2,000,000 |
| Private Sector | Relevant companies and farmer cooperatives in project sites[[5]](#footnote-5) | Grant | Investment mobilized | 50,000,000 |
| In-kind | Recurrent expenses | 5,000,000 |
| GEF Agency | United Nations Development Programme | Grant | Investment mobilized | 200,000 |
| **Total Co-financing** | | | | 70,200,000 |

Describe how any “Investment Mobilized” was identified. *The proposed implementing partners for this project (MIIT and MNR) have been developing and implementing projects (including those funded by the GEF). Both ministries are also mobilizing counterpart funding to such projects. They work together with multi-lateral and bilateral donor agencies for funding projects that especially are geared towards the development and conservation of the country’s natural resources, and the development of the industry and information technology sectors. The various local governments that will be working on this proposed project themselves are also doing their own financial mobilization efforts for provincial socio-economic development. During the stakeholder consultations that were conducted with the technical personnel in both ministries, they committed to seek expressions of interest and commitments from these local governments to participate and co-finance the envisioned activities of this proposed project. In that regard, the project would leverage some of the ongoing and planned investments and initiatives in the project partners. Both ministries will explore further commitments as needed during the design and development stage of the project.*

1. Indicative Trust Fund Resources Requested by Agency(ies), Country(ies), Focal Area and the Programming of Funds

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **GEF Agency** | **Trust Fund** | **Country/**  **Regional/ Global** | **Focal Area** | **Programming**  **of Funds** | **(in $)** | | |
| **GEF Project Financing (a)** | **Agency Fee (b)** | **Total**  **(c) = a+b** |
| UNDP | GEFTF | China | Climate Change | CC STAR Allocation | 9,389,041 | 891,959 | 10,281,000 |
| **Total GEF Resources** | | | | | 9,389,041 | 891,959 | 10,281,000 |

1. Project Preparation Grant (PPG)

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

**PPG Amount Requested** by Agency(ies), Trust Fund, Country(ies) and the Programming of Funds

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **GEF Agency** | **Trust Fund** | **Country/**  **Regional/Global** | **Focal Area** | **Programming**  **of Funds** | **(in $)** | | |
| **PPG** (a) | Agency  Fee(b) | **Total**  c = a + b |
| UNDP | GEFTF | China | Climate change | CC STAR Allocation | 200,000 | 19,000 | 219,000 |
| **Total PPG Amount** | | | | | 200,000 | 19,000 | 219,000 |

1. Project’s Target Contributions to GEF 7 Core Indicators

*Provide the relevant sub-indicator values for this project using the methodologies indicated in the Core Indicator Worksheet provided in Annex B and aggregating them in the table below. Progress in programming against these targets is updated at the time of CEO endorsement, at midterm evaluation, and at terminal evaluation. Achieved targets will be aggregated and reported at any time during the replenishment period. There is no need to complete this table for climate adaptation projects financed solely through LDCF and SCCF.*

|  |  |  |
| --- | --- | --- |
| **Project Core Indicators** | | **Expected at PIF** |
| 6 | **Greenhouse Gas Emissions Mitigated** (metric tons of CO2e) | 36.47[[6]](#footnote-6) million tons (by end-of-project) |
| 11 | Number of **direct beneficiaries disaggregated by gender** as co-benefit of GEF investment |  |

*Provide additional explanation on targets, other methodologies used, and other focal area specifics (i.e., Aichi targets in BD) including justification where core indicators targets are not provided.*

1. Project Taxonomy

Refer to Annex C

part ii: project JustiFication

**1a. *Project Description.***

**1a.1: Global environmental and/or adaptation problems, root causes and barriers that need to be addressed**

**Global environmental problems and their causes**

Since the 19th century, the rapid development of industry and the scale of human activities have become the main contributors to global climate change. At present, the global average land and ocean surface temperature is 0.85 ℃ higher than before, and the atmospheric CO2 concentration is more than 400 ppm. In October 2018, the United Nations Intergovernmental Panel on Climate Change warned that if global warming is not controlled within 1.5 ℃, the earth will usher in a devastating climate after 2030. According to science news of the United States, by the end of 2019, global CO2 emissions from fossil fuel combustion will reach 36.8 billion tons, up from 36.57 billion tons in 2018. To actively contribute to the global call for slowing down climate change, China committed in 2015, as per China's Nationally Determined Contributions (NDC) document that was submitted to the United Nations Framework Convention on Climate Change (UNFCCC), to increase the share of non-fossil fuels in the national energy mix to 20% by 2030; and to reduce its carbon intensity by 60% to 65% of the 2005 levels by 2030. In 2020, China put forward a more ambitious goal to the fight against climate change, as it aims to bring carbon emissions to a peak by 2030 and achieve carbon neutrality by 2060 with more forceful policies and measure.

Low-carbon transformation of the phosphate chemical industry (PCI) in China is regarded as an important component of China’s response to global climate change. The PCI is an important sub-sector of China’s industry sector. Fig. 1 shows the flowchart of the PCI chain in China. At present, the PCI is a relatively mature industry, which covers phosphate mining and refining and the production of phosphate chemical products. There are about 100 different phosphate chemical products that are produced by the industry, which can basically meet the domestic demand, and a large portion of the production is exported. In 2015, the Ministry of Agriculture issued the notice of action plan for zero growth of fertilizer use by 2020. The sales volume of phosphate fertilizer showed a downward trend in recent years. In 2018, the sales volume of phosphate fertilizer was 12.97 million tons, which was 17.1% lower than that in 2017. However, the demand for phosphate fertilizer has a certain degree of rigidity. With the increase in domestic fertilizer utilization rate and compound fertilizer conversion rate, the probability of phosphate fertilizer demand continuing to decline sharply is not high. On the whole, the situation of capacity contraction of China's PCI has little change in the short term. Although the industry demand has a certain decline, the demand will tend to become stable in the later stage.

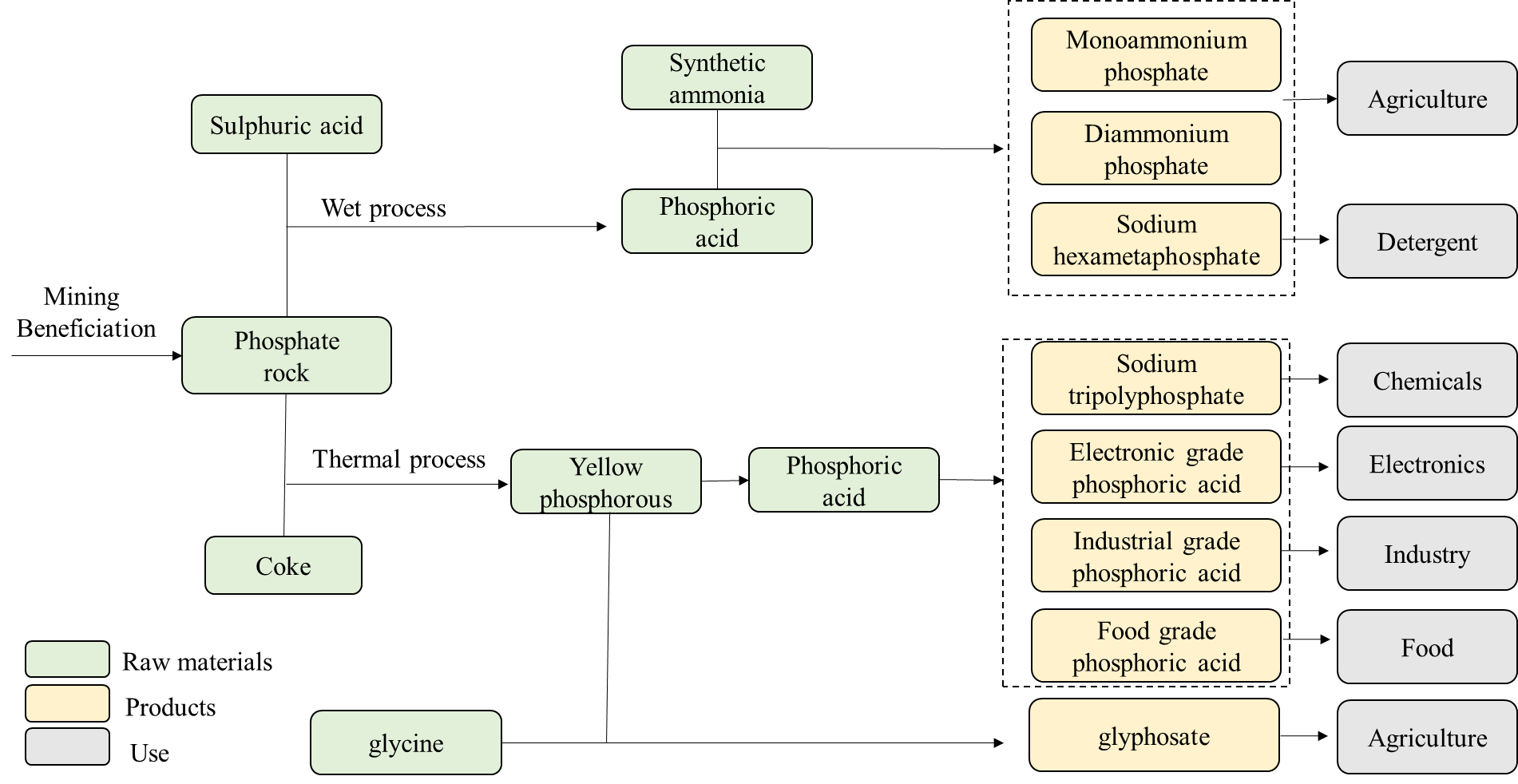


Figure 1. The flowchart of PCI chain in China.

The carbon emission problem in the PCI in China is mainly manifested in three aspects, which are also the key problems to be solved in this project.

1. **High energy consuming and GHGs emission in the chemical production process**. In terms of production capacity and output, China is the largest producer, exporter, and consumer of phosphate chemical products in the world, accounting for more than 80% of the world's total production capacity. In 2019, the national phosphate fertilizer production capacity was 22.5 million tons of P2O5. In 2019, the carbon emission of the PCI was about 59 million tons CO2eq, accounting for about 4.3% of the carbon emission of the chemical industry. The extensive production mode of the PCI causes a lot of energy waste
2. **The inadequate utilization of the industry by-products particularly phosphogypsum**. At present, the annual output of phosphogypsum in China is about 85 million tons. The comprehensive utilization rate of this byproduct is about 40%, and the annual additional storage of phosphogypsum is 51 million tons. The historical storage of phosphogypsum in China is more than 800 million tons, and the problems of environmental pressure and safety risks are increasingly prominent. Among them, nearly 650 million tons of phosphogypsum piles exist along the main stream and upstream tributaries of the Yangtze River in the provinces of Hubei, Yunnan, Guizhou, Sichuan, etc., which is the key and difficult problem in the ecological environment restoration of the Yangtze River economic belt. In addition, the low quality of phosphate concentrate leads to high energy consumption in the downstream phosphoric acid production, and the disposal of by-product phosphogypsum is difficult. Phosphate rock needs to be enriched to obtain the proper phosphate concentrate before it can be used in to produce phosphate fertilizer. At present, the grade of phosphate concentrate in China is about 28-30%, and the main impurity is silica. In other countries, phosphate concentrate is mainly extracted from apatite, and the highest grade of phosphate concentrate can reach 40%. When the grade of phosphate concentrate is increased by one percentage point, the consumption of sulfuric acid and phosphogypsum production can be reduced by 17.2 kg and 10 kg, respectively.
3. **The ecological environment impact in the process of phosphate rock mining**. The development of mineral resources such as phosphate rock is of great significance for human survival. The extraction of mineral resources like phosrock involves several energy consuming physical and chemical separation processes, as well as the generation of gaseous emissions, liquid effluents, and solid waste materials. In order to obtain the resources, it is usually necessary to refine or beneficiate the mined mineral produce value added materials. In the mining development activities, due to the social development level and development and utilization technology and other reasons, there are various problems in the production process, such as high energy consumption, large volume of waste materials, and waste rock tailings management. China's phosphate rock resource endowment is poor, and consequently its extraction and utilization requires high energy consumption, and the resource utilization rate is low. Collophanite is the main phosphate rock in China. This kind of resource is produced in layers, which has the characteristics of thin ore body, low grade of raw ore, high impurity content and difficult separation. Moreover, the phosrock mining areas are typically large, the land surface damage is serious, and the comprehensive utilization rate of waste rock and tailings is low. Yunnan, Guizhou, and Sichuan will discharge 104.7118 million tons of waste rock in 2019, and 41.3922 million tons of waste rock will be used in the same year, with an average utilization rate of 39.53%. In 2019, 9991500 tons of tailings will be discharged, and 2384000 tons of tailings will be used in the same year, with an average utilization rate of 23.86%. A large number of waste rocks and tailings can only be stacked in the waste rock dump and tailings pond for a long time.

**Obstacles to achieve green and low-carbon development of PCI chain**

**The existing extensive development mode of PCI chain.** At present, the development mode of phosphorus chemical industry in China is an extensive mode of pursuing economic benefits. Most enterprises do not take reducing carbon emissions and achieving cleaner production as their social responsibility, but only maximize their economic benefits in the framework of meeting industry regulations. The attribute of enterprises pursuing short-term interests makes it difficult to realize green and low-carbon development mode through internal forces

**The standard system and related policies are not sufficient.** Resource development includes many processes and operations including resource exploitation, enrichment, refining, product manufacturing, waste management (e.g., recycling, reprocessing, reuse), etc. The low quality of upstream raw materials leads to the lower reaches can obtain the target products, but the energy consumption is increased, and the amount of waste products is large. The general scenario is that the waste produced in the downstream is more difficult to use, resulting in a large amount of stacking, which leads to a direct threat to the ecological environment. There are some relevant standards for phosphogypsum comprehensive utilization products, but most of these standards are formulated by referring to the relevant building materials industry standards. Because the standard system of phosphogypsum comprehensive utilization products is not perfect and the market recognition is low, it is difficult to apply them on a large scale. In terms of building materials, the current gypsum specifications and construction technology are not perfect, so it is necessary to promote the generalized application of phosphogypsum in the construction industry and compile a series of standard system from the top-level design. It is necessary to strengthen the cooperation among various parts, formulate a unified standard system, increase the waste utilization income, and transmit it to the whole industrial chain, so as to ensure that the whole industrial chain can obtain benefits from the green and low-carbon development action.

**The innovative technology of PCI in China is still insufficient.** At present, there is a lack of technological innovation in the process of PIC in China. One is the innovation of resource development and utilization technology, including the research and application of new technology, new process and new equipment of ore mining and dressing, which can reduce the discharge of solid waste such as waste rock and tailings, reduce energy consumption in the process of development and utilization, improve the quality of concentrate and reduce the complexity of subsequent operations. The second is clean production technology and by-product treatment technology of PIC. As the disposal of phosphogypsum in China has not been paid enough attention, the existing phosphogypsum disposal and comprehensive utilization technology has the problems of poor economy and low popularization value, and lacks some economic key technologies, such as on-line quality control technology of phosphogypsum production and discharge, pretreatment technology of low-cost secondary pollution, key common technology of large consumption and high value-added utilization.

**There is a lack of cooperation among different regions in China**. Affected by the distribution of regional resources and transportation radius, the production, storage, and comprehensive utilization of phosphogypsum vary greatly in different regions. The discharge and storage of phosphogypsum are mainly concentrated in Yunnan, Guizhou, Sichuan, and other southwest regions, while the consumption of gypsum is mainly concentrated in areas with large demand for building gypsum and cement, such as the eastern provinces and cities with developed economy in China. Due to the influence of transportation radius, the supply of gypsum in the area with large amount of gypsum is in short supply, while the area with concentrated emission can only be stored in large quantities. The spatial mismatch between demand and production places makes the comprehensive utilization policy of phosphogypsum need to be coordinated and promoted by different regional governments.

**1a.2. Baseline scenario and any associated baseline projects**

**Baseline scenario**

**Current situation and future forecast of energy consumption and carbon emission of PCI**

1. For phosphorus chemical products, carbon emissions per ton of phosphorus chemical products decreased from 1.62 tons of carbon dioxide to 1.31 tons of carbon dioxide, from 2010 to 2019, a cumulative reduction of 19%. According to the current relevant policies of the Chinese government, it is estimated that the carbon emission per ton of phosphorus chemical products will be reduced to 1.25 tons of carbon dioxide in 2025. However, due to the limitation of phosphorus chemical technology, there is still a big gap between the current carbon intensity and the level of developed countries (1.2 tons). There is still a huge space for carbon emission reduction by incorporating advanced technologies.
2. For phosphate mining, the average energy consumption per ton of raw ore in China's phosphate mining link is 1.94 kg standard coal in 2019, and the corresponding carbon emission is 5.04 kg CO2. The average energy consumption per ton of raw ore is 7.93 kg standard coal, and the corresponding carbon emission is 20.6 kg. The average utilization rate of waste rock is 39.53%. The average utilization rate of tailings is 23.86%. It is estimated that energy consumption will decrease by 3% and utilization rate will increase by 3% in 2025. Compared with developed countries, mining efficiency, beneficiation efficiency, waste rock utilization rate and tailings utilization rate have an obvious gap, and there is a very large space for increase (about 10%). The comprehensive utilization of tailings can prepare biological phosphate fertilizer instead of phosphate fertilizer, so as to reduce carbon emission in the process of phosphate fertilizer production.
3. For phosphogypsum, the annual output of phosphogypsum in China will be about 85 million tons in 2019, including 69 million tons in Hubei, Yunnan, Guizhou and Sichuan, accounting for 81.2% of the national total. From 2010 to 2019, the comprehensive utilization rate of phosphogypsum will increase from 20.3% to 39.7%. According to the current relevant policies of the Chinese government, the comprehensive utilization rate of phosphogypsum is expected to increase to about 42% in 2025. At present, there is still a big gap between the utilization rate of phosphogypsum and that of developed countries (more than 55%). About 1.0 tons of carbon emissions will be generated per ton of cement gypsum to replace cement, so the carbon emission will be about 1.0 tons per ton of cement gypsum. At present, China has a large amount of phosphogypsum accumulation and production, if the comprehensive utilization rate of phosphogypsum reaches the level of developed countries, it will produce very large carbon emission reduction benefits.

**Relevant policies and measures.**

In recent years, the Chinese government has made some efforts for the low-carbon transformation and green development of the PCI chain, and has made preliminary achievement.

1. The government promotes the energy conservation and emission reduction of phosphate rock through the strategy of building "green mine". In 2017, the Ministry of Land and Resources, the Ministry of Finance, the Ministry of Environmental Protection, the General Administration of quality supervision, inspection and Quarantine of the people's Republic of China, China Banking Regulatory Commission and China Securities Regulatory Commission jointly issued the implementation opinions on speeding up the construction of green mines. See baseline project 1. It requires all newly-built mines to meet the requirements of green mine construction. In 2019, 953 mines in China met the green mine standard, of which 37 were phosphate mines, accounting for 3.88%. 12.3% of all phosphate mines in China passed the green mine selection. In 2019, the Ministry of natural resources issued the notice of the general office of the Ministry of natural resources on updating the catalogue of advanced and applicable technologies for saving and comprehensive utilization of mineral resources. It requires the technical progress recommended by the provincial natural resources’ authorities through selection and comprehensive demonstration and screening with the first six batches of 334 technologies from 2012 to 2017. 360 technologies were finally selected, including 19 technologies involving phosphate rock development.
2. The phosphorus chemical industry has policy constraints on environmental protection and energy saving. The Ministry of Ecological Environment issued the implementation plan for the special investigation and remediation action of "three phosphorus" in the Yangtze River, focusing on the pollution of "three phosphorus" on May 2, 2019. The plan specifies the overall requirements and work arrangements for the special investigation and regulation of "three phosphorus" projects in the Yangtze River, which can be summarized as three key points and five stages. China Inorganic Salt Industry Association put forward the 13th five year plan development idea of phosphorus chemical industry and put forward the target of energy utilization efficiency of the industry. The Ministry of Industry and Information Technology also supports the research and development of key technologies for green and low-carbon development of phosphorus chemical industry, such as baseline projects 2 and 3.
3. The government has gradually attached importance to the treatment and disposal of phosphogypsum. In 2011, the Ministry of Industry and Information Technology issued the "guidance on comprehensive utilization of industrial by-product gypsum", to improve the tax preferential policy of industrial by-product gypsum used in cement retarder production, and guide enterprises to use industrial by-product gypsum as cement retarder. Local governments have gradually attached importance to the comprehensive utilization of phosphogypsum. In 2017, Guizhou Province formulated a special plan for the development of phosphogypsum industry and implemented the "fixed production by use" of phosphogypsum. Governments in Hubei, Sichuan, Yunnan, and other provinces have issued policies to promote green transformation of phosphorus chemical industry. The Ministry of industry and information technology issued the "industrial green development plan (2016-2020)", which proposed to promote a number of advanced and applicable technology and equipment around phosphogypsum and other industrial solid waste and promote deep resource utilization.

Although national and local governments have made efforts to promote the energy conservation and emission reduction of the PCI chain, there are still some fundamental obstacles that are difficult to overcome in the short term, which need the support of external forces and funds. It is mainly reflected in the obstacles of cooperation between different departments in formulating standard policies, the technical barriers in the process of incorporating green and low-carbon technologies into the existing PCI process, and the financial obstacles for enterprises to carry out spontaneous low-carbon green transformation.

**Baseline Projects**

The following table lists the completed and ongoing projects that can promote the green and low-carbon development of the phosphorus industry chain and play a positive role in the future. The related activities of these projects are also the baseline activities of the declared projects.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Project** | **Project outputs that can be used in the proposed project** | **Implementation period** | **Source of funds** | **Executive Agency** |
| Construction of green phosphate mines | Promote some phosphate mines to realize energy saving and emission reduction | 2017-2022 | Ministry of Land and Resources, Ministry of Finance, Ministry of Environmental Protection, AQSIQ, CBRC and CSRC | Various phosphate mine companies |
| Wet purification phosphoric acid green manufacturing system integration project | Construction of phosphogypsum modified building gypsum powder and α - type high strength gypsum. | 2018-2020 | Ministry of Finance  Ministry of Industry and Information Technology | Wengfu (Group) Co., Ltd |
| Green key process system integration project of phosphate fertilizer chemical industry | Developed and applied green key technologies for phosphate fertilizer production  Results of the green phosphate fertilizer production demonstration. | 2017-2021 | Ministry of Finance  Ministry of Industry and Information Technology | Guizhou Kailin group mineral fertilizer Co., Ltd |

**1a.3: The proposed alternative scenario with a brief description of expected outcomes and components of the project**

**Proposed Alternative Scenario**

This project will develop and promote a green, low-carbon sustainable development model for the PCI in line with China's national circumstances, form a green low-carbon development system for phosphate ore mining, improve energy efficiency in the industry, and establish a circular economy model for phosphorus chemical industry. In accordance with the characteristics of the location distribution of the phosphorous industry and the treatment needs of phosphogypsum, this project will promote resource recycling and integrated management of the whole industry chain. Pilot projects will be implemented in industrial parks, industrial agglomeration areas and core enterprises in Yunnan, Guizhou, Sichuan, and Hubei regions. The project will cover the following:

1. Green and low carbon mining of phosphate rock (phosrock) and recycling of phosrock mining tailings. By identifying key links of energy conservation and emission reduction, improvement opportunities and technological demands in the process of phosrock mining and refining, the application of feasible green and low carbon technologies in this PCI sub-sector can be identified and appropriately demonstrated. Through the application of new technologies and equipment, the utilization rate of resources can be improved, waste storage can be reduced, and ecological restoration and reclamation can be carried out to maximize the ecological benefits of mining activities. Strengthen the phosphate ore recycling technology research and development and mode promotion, carry out the application of advanced applicable technology and pilot demonstration, improve the use of phosphorus tailings, improve the utilization rate of phosphate ore resources, reduce the use of phosphate ore, thus reducing the carbon emissions of phosphate fertilizer chemical industry.
2. Promoting the cost-effective application of energy efficient, green, low-carbon technologies/techniques and measures in the production of phosphate chemicals. In the phosphorous chemical products production establishment of standard of product green design, green design products, to set up the demonstration project, the green design in the phosphorous chemical industry factory level to form green manufacturing system integration, energy saving technology and equipment in the industry level, the greatest degree to promote phosphorus chemical production, energy saving and efficiency increasing reduce carbon emissions of whole life cycle of phosphorus chemical industry.
3. Integrated utilization of phosphogypsum. The integrated utilization of phosphogypsum to produce cement and concrete will be implemented. This need take measure to improve the pretreatment technology of front end phosphogypsum, develop the purification treatment technology of sealed phosphogypsum, improve the level of solid waste resource utilization in the phosphorous chemical industry, and reduce the energy consumption and carbon emission caused by the use of cement. The project will also explore the recycling potential and technical routes of historic phosphogypsum deposits and develop environmental standards to minimize waste production and environmental impacts in the phosphorous chemical industry.

**Components of the Proposed Project**

The objective of the proposed project is the facilitation of the extensive application of low carbon and energy efficient technologies in the phosphate chemicals industry in China. The strategy to achieve this objective is to remove the barriers that hinder the promotion and deployment of these technologies, including applicable energy efficient techniques, measures and practices in cleaner production in the 3 sub-sectors of the phosphate chemicals industry, namely: (1) Phosrock mining and refining; (2) Phosphate chemicals production; and, (3) By-products and waste processing. In this regard, there will be 3 project components, one for each sub-sector. Each project component is comprised of activities addressing the various barriers (i.e., policy/regulatory, institutional, technical, financial, information and awareness). The achievement of the project objective will contribute to the achievement of China’s climate change mitigation targets and the achievement of the United Nations 2030 Sustainable Development Goals (SDGs), specifically SDG 3 "Good health and well-being"; SDG – 7 “Sustainable Energy”; SDG 9 "Industry, Innovation and Infrastructure"; and, SDG 13 "Climate Action”.

**Component 1: Green and Low-carbon Development and Operation of Phosphate Mines**

This project component is intended for the removal of barriers to the application of green, energy efficient low carbon technologies/techniques and practices in the mining and refining of phosphate rock (phosrock) for use in the production of phosphate chemicals. The delivery of the envisioned outputs from this project component will bring about two main outcomes: (1) Improved interest and commitment of the phosphate chemical industry in the green, low carbon and energy efficient operations of the phosphate mining sub-sector in China; and, (2) Enhanced confidence in the feasibility of the application of green, energy efficient low carbon technologies in phosrock mining and refining in China.

To bring about the first outcome, the following indicative activities will be implemented: (1) Formulation and advocacy work for the approval and enforcement of policy and institutional frameworks supporting green, energy efficient low carbon development initiatives in phosphate rock (phosrock) mining and refining; (2) Formulation and enforcement of standards, policies and implementing rules and regulations on the promotion and practice of green, energy efficient, low carbon technologies/techniques, in the development and operations of phosphate mines; (3) Documentation and annual evaluation of the energy performance and environmental impacts of each demo project; (4) Design, conduct and post-evaluation of a capacity development program on the principles and application of green, energy efficient low carbon technologies/techniques in phosphate mining and refining; (5) Preparation, publication for dissemination of technical guides and reference documents for the application of energy conserving and energy efficient practices in the phosphate mining sub-sector; (6) Establishment of an online monitoring, reporting and verification system for energy-saving and GHG emission reduction from the application green, energy efficient low-carbon technologies in the PCI; and, (7) Publication and dissemination of publicity information about China's green, energy efficient and low-carbon phosrock mining and refining.

The second outcome will be realized with the delivery of the required outputs from the implementation of these indicative activities: (1) Design, engineering, financing and implementation planning of demonstrations of green, energy efficient and low carbon technologies in phosphate mines development and operations; (2) Installation of the designed/engineered and operational green, energy efficient low carbon technology application demos in phosrock mining and refining; (b) Operation, monitoring and evaluation of the demo facilities; and, (3) Preparation and approval for financing of a follow-up plan for the replication of the application of demonstrated green, energy efficient low carbon technologies in phosrock mining and refining in other localities.

**Component 2**: **Green and Low-Carbon Design and Operation of Phosphate Chemicals Production Facilities**

This component of the project will address the barriers to the application of green, energy efficient low carbon technologies/techniques and practices in phosphate chemicals production. This is comprised of activities that will deliver outputs that will collectively bring about two main outcomes: (1) Enhanced interest and commitment of the phosphate chemical industry in the green, low carbon and energy efficient production of phosphate chemicals in China; and, (2) Enhanced confidence in the feasibility of the application of green, energy efficient low carbon technologies in phosphate chemicals production in China.

To bring about the first outcome, the following indicative activities will be carried out: (1) Formulation, recommendation and enforcement of policy and institutional frameworks supporting green, energy efficient low carbon technology applications in phosphate chemicals production; (2) Development and enforcement of standards, policies and implementing rules and regulations on the promotion and practice of green, energy efficient, low carbon technologies/techniques, in phosphate chemicals production; (3) Preparation of annual evaluation reports on the energy performance and environmental impacts of each demo including demo results based on the MRV system established under Component 1; (4) Design, conduct and post-evaluation of capacity development program on the principles and application of green, energy efficient low carbon technologies/techniques in phosphate chemicals production; (5) Publication and dissemination of technical guides and reference documents for the application of energy conserving and energy efficient practices in the phosphate chemicals production sub-sector; and (6) Conduct of a market analysis of the international trade trends for phosrock and phosphate chemicals, and the indirect carbon emission and ecological impacts in the international trading of these products.

The following are the indicative activities to be implemented to deliver the outputs that will collectively bring about the second outcome: (1) Design and promotion for approval of pilot financing scheme for small and medium enterprises (SMEs) that manufacture phosphate chemicals; (2) Design, engineering, financing and planning of demonstrations of green, energy efficient low carbon technologies in phosphate chemicals production[[7]](#footnote-7); (3) Installation of the systems/facilities for the demonstration of the application of green, energy efficient low carbon technologies and techniques in phosphate chemicals production; (4) Operation of the installed demos in demo phosphate chemicals manufacturing companies; (5) Operation of the pilot financing scheme for phosphate chemicals SMEs for the implementation of green, energy efficient low carbon technologies in their production operations; and, (6) Preparation and approval of financed follow-up plan for the replication of the application of demonstrated green, energy efficient low carbon technologies in phosphate chemicals production in other localities.

**Component 3: Green and Low Carbon Design and Operation of Waste Management Systems in the Phosphate Chemicals Industry**

This component of the project will address the barriers to the application of green, energy efficient low carbon technologies/techniques and practices in waste management systems in the phosphate chemicals industry. This focuses on the green and low carbon management of solid wastes generated in phosrock mining and refining and in phosphate chemicals production. It is comprised of activities that will deliver outputs that will collectively bring about two main outcomes: (1) Enhanced commitment of the phosphate chemical industry in green and low carbon waste management; (2) Increased confidence in the feasibility of the application of green and low carbon technologies in the management of waste in the phosphate chemicals industry in China.

To bring about the first outcome, the following indicative activities will be implemented: (1) Conduct of research on circular economy schemes application in the phosphate industry in China and in other countries; (2) Formulation and recommendation of schemes, standards, policies/regulations on the application of green and low carbon waste management technologies in the phosphate chemicals industry in China; (3) Monitoring, reporting and evaluation of the energy performance and environmental impacts of each demo based on the MRV system developed under Component 1; (4) Design, conduct and post-evaluation of capacity development program on the principles and application of green and low carbon waste management technologies/techniques in the phosphate chemicals industry; (5) Publication and dissemination of: (a) technical guides and reference documents for the application of green and low carbon technologies/techniques in waste management in the phosphate chemicals industry; and (b) publicity information about China's green and low-carbon waste management in the phosphate chemicals industry.

The indicative activities that will deliver the outputs that will collectively bring about the second outcome are the following: (1) Designing, engineering, financing and planning of demonstrations of the application of green and low carbon technologies/techniques in waste management in the phosphate chemicals industry, specifically on phosrock mining tailings recycling and reuse; and, (b) energy efficient processing of phosphogypsum and marketing of the gypsum products; (2) Installation of the demo facilities for showcasing cost-effective green and low carbon waste management technology application in the phosphate chemicals industry; (3) Commercial operation and maintenance of the installed demo facilities in the partner phosphate chemical industry companies; and, (4) Preparation and approval of financed follow-up plan for the replication of the application of demonstrated green, low carbon waste management technologies in the phosphate chemicals industry in other localities.

**1a.4: Alignment with GEF focal area and/or Impact Program strategies**

This project is in line with GEF-7 climate change mitigation objective of promoting innovation and technology transfer. This project is in line with the specific entry points under CCM-1.3: Acceleration of promoting energy efficiency, and CCM-1.4: Clean technology innovation. At present, China attaches great importance to promoting the energy conservation and green development in its major industry sectors such as the phosphate chemicals industry (inclusive of phosrock mining, phosphate chemical production, and by-products processing). The country has existing policies and programs on industrial energy conservation and on green, and low carbon development that can support the achievement of a more energy efficient and environment-friendly phosphate chemical industry. However, despite these bringing positive progress in the industry, there is still significant room for improvement in the understanding and application of green, energy efficient low-carbon technologies in this major energy consuming industry in China. The facilitation of the widescale application of these technologies is the objective of the project, and this will be done through the removal of identified barriers/problems through various technical assistance and investment-type barrier removal activities.

Additionally, the implementation of this project will mobilize more rural women in the project areas and enable women to play significant roles in the implementation of this project. This is in line with the UN's sustainable development goals for poverty eradication, gender equality, gender equality and empowerment of all women and children, as well as the GEF's focus on women's equality.

**1a.5: Incremental/additional cost reasoning and expected contributions from the baseline, the GEFTF, LDCF, SCCF, and co-financing**

This project will collaborate with relevant projects that have been planned and budgeted in the phosphate chemicals industry. Funded by relevant ministries (mainly MIIT) and local governments, these projects have different focus, including improvement of mining capacity, energy conservation and emission reduction, and minimizing industrial pollution. At present, current projects are mainly on PCI technological innovation and integration (as listed in *Baseline Scenarios*), which focus only on cleaner production. Phosphogypsum replacing cement and phosphate rock tailings producing phosphorus-containing biological fertilizer projects are not supported by any existing project. New projects are needed to achieve (1) energy conservation in mining operations, (2) clean production technology of phosphate chemical industry, and (3) phosphogypsum replacing cement in concrete. Lack of knowledge and experience in design, operation, investment, and financing of such projects constitute obstacles to project implementation. In this context, it is difficult to realize the benefits of clean production and recycling of phosphogypsum and phosphate rock tailings.

Currently there are barriers for introducing the low-carbon PCI, including high costs of technologies, lack of incentives to retire existing technologies, and lack of capacity in developing new markets. Incremental activities in this project is therefore mainly on forming new policies and market mechanisms, which removes these barriers. Firstly, since local stakeholders lack the capacity and incentives to deploy high energy efficiency technologies, the project provides subsidy and training programs to encourage local PCI enterprises to turn to more energy efficient technologies. Secondly, this project will build a market to recycle phosphogypsum and replace cement in concrete. GEF funding will be used to hold workshops to decide market mechanisms and price information and provide subsidies for recycling where necessary. Also, this project will formulate the methodology of calculating the emission reduction of such transactions, so that it can participate in the national carbon market in the future and provide lasting economic incentives for the comprehensive utilization of phosphogypsum. Since phosphogypsum recycling requires cleaning pollutants off phosphogypsum and sound management of phosphogypsum waste, this project will formulate industrial standards, seek the most cost-effective technical pathways in phosphogypsum pollution control by consulting experts in this area. In case phosphogypsum replacement of cement plant production activities resulting in unemployment, technology training will be developed to transfer work force to the preparation and purification of phosphogypsum from cement plants. Without such activities, it is impossible to realize the expected alternative of clean and low-carbon development of phosphorus chemical industry. Incremental activities to establish and implement supportive policy and regulatory frameworks (through effective institutional arrangements, financial incentives, information sharing, etc.) are necessary to support the replication and promotion of phosphorus chemical emission reduction projects in villages and towns of other provinces in China and even other developing countries. Without the GEF project, the substantial sustainable development benefits generated by the application of these programs will not be realized.

Chinese government will also support the PMO in terms of salaries, offices, equipment, and materials for central and local project managers. The demonstration plants will provide capital and technology in the removal of pollutants attached to phosphogypsum to support the implementation of this project. The Chinese government and private enterprises are the main agencies of the technology demonstration and extension project construction, and the overall supporting funds will not be less than 10 times of GEF funds.

**1a.6: Global environmental benefits (GEFTF) and/or adaptation benefits (LDCF/SCCF)**

The benefits of this project includes two parts (six aspects in total): benefits of the low-carbon energy-saving project of phosphorus mine, including (1) the improvement of energy-saving and emission reduction level of phosphate rock resources, and (2) green mine construction; and the comprehensive utilization benefit of phosphogypsum, including (3) the greenhouse gas emission reduction capacity brought by the comprehensive utilization of phosphogypsum instead of cement production, and (4) the emission reduction capacity of phosphorus chemical industry brought by energy-saving and green technology, (5) the emission reduction capacity of phosphorus containing biological fertilizer produced by the recycling of phosphorus tailings, and (6) the less of land occupation brought and environmental safety and human health risks of phosphogypsum by the reduction of phosphogypsum stacking in the demonstration project.

In terms of improving the level of energy conservation and emission reduction of phosphate rock resources, the first environmental contribution is to effectively prevent geological disasters and soil erosion through the transformation and upgrading of phosphate mining technology; the second is to reduce unit energy consumption through the optimization and transformation of beneficiation and metallurgy technology and subsequent production technology of phosphorus chemical products.

The implementation of this project will vigorously promote the conservation and comprehensive utilization of mineral resources and improve the ecological environment of the mine and its surrounding areas. This project will significantly improve the living environment conditions of the mine, and reduce the threat and harm of soil and water environmental pollution caused by tailings and backwater discharge to the health of enterprise employees and nearby residents, The successful implementation of this project will provide technical support for energy conservation and emission reduction in mineral resource enterprises and green mine construction in China and countries on the ‘Belt and Road’ initiative.

Based on preliminary calculation, the emission reduction in Yunnan, Guizhou, Sichuan, and Hubei pilot areas will be 7.39 million tons of CO2/year, including: comprehensive utilization of phosphogypsum to replace cement in concrete, energy saving and consumption reduction in phosphorus chemical production process, and biomass phosphate fertilizer production from tailings recycling. It should be noted that with the progress of the project application and approval process, the Ministry of industry and information technology and other departments will organize experts to conduct further detailed analysis and calculation on the emission reduction effect in the PPG stages, so as to further improve the preliminary estimation of the emission reduction effect of this project.

In addition, this project will reduce the pollution of nearby water bodies by reducing the stacking of phosphogypsum. Yunnan and Sichuan are important water sources in the upper reaches of the Yangtze River. If the prevention and control of phosphogypsum stacking is not in place, it will cause pollution to the main and tributaries of the Yangtze River. At the same time, Yunnan, Guizhou, Sichuan, and Hubei areas are also ecologically fragile areas in China. Phosphogypsum, due to its high leachate concentration, has brought important ecological risks. The comprehensive utilization of phosphogypsum will reduce the stacking of phosphogypsum in the demonstration project area of Yunnan, Guizhou, Sichuan, and Hubei, so as to reduce water pollution and ecological damage, and protect the fragile ecology of these areas.

In addition to reducing carbon emissions and industrial waste from the phosphorus chemical industry, the implementation of this project will also reduce the regional pollutant concentration in rural areas of Yunnan, Guizhou, Sichuan, and Hubei, promote the sustainable improvement of ecological environment in rural areas, and protect the livelihood of rural areas. This project will require harmless treatment of wastewater from phosphogypsum, reduce the content of phosphorus and heavy metals in wastewater, and ensure the ecological and people’s health in rural areas of Yunnan, Guizhou, Sichuan, and Hubei. The successful implementation of this project will provide technical support and sharing for phosphogypsum recycling in developing countries and provide experience for promoting green and low-carbon development of the whole industrial chain of global phosphorus chemical industry.

**1a.7: Innovation, sustainability, and potential for scaling up**

*Innovativeness:* This project has at least the following three aspects of innovation:

a) This project will promote China's phosphate mines and phosphorus chemical industry to get rid of the extensive development model, solve the problems of low added value of products, high resource consumption and high environmental protection pressure, innovate the industrial development model, and promote the green transformation of the industry.

b) This project will innovate the management of carbon emission reduction, improve the management system and mechanism for the phosphorus industry to respond to climate change, and enhance the awareness and ability of enterprises and public organizations to respond to climate change. At the same time, this project will improve the policy system, give full play to the main role of enterprises and the role of market mechanism, and balance the relationship between economic development and environmental protection.

c) This project will innovate the comprehensive assessment methods of energy conservation and emissions reduction, improve the carbon accounting system of the industry, analyze the synergies between emission reduction of phosphorus industry and other industries, measure the comprehensive impact of the phosphorus industry to the environment, and formulate the standards of energy conservation and low-carbon development of the industry

*Sustainability:* Firstly, this project will strengthen the policy guidance of phosphorus industry, summarize the low-carbon development model, formulate the energy saving and green low-carbon development plan during the 14th five-year Plan period of China, and work out a special action plan, which will provide complete institutional guarantee in project implementation. Secondly, this project will explore the incentive and subsidy policies to partially compensate the cost increase caused by the improvement of technology, share the risk of technological innovation, and alleviate the economic pressure of enterprises. At the same time, more enterprises will be encouraged to accelerate the implementation of comprehensive utilization of phosphogypsum by reducing the costs, so as to provide economic security for the implementation of this project. Thirdly, this project will develop professional skills training programs for employees in the phosphorus industry, accelerate the R&D and promotion of key technologies, engineering processes and production processes, promote the transformation and diffusion of scientific and technological achievements, cultivate high-end skills, and provide sustainable talent guarantee for green development. Fourthly, this project will achieve a new model of coordinated development of low-carbon phosphorus industry and ecological compensation, poverty reduction, ecological diversity improvement, guarantee of agricultural and food security, improve the level of social and economic development and the quality of ecological environment, effectively improve the happiness and sense of gain of residents, and provide continuous public support and participation for the implementation of this project.

*Scale-up Potential:* On the basis of establishing the demonstration benchmark and improving the supporting system, this project provides a series of replicable, sustainable, and extensible empirical model for the energy conservation and green and low-carbon transformation. At the same time, through the design and implementation of the promotion program, to provide the possibility for the application of these models in other regions of China and other countries.

The ways of large-scale promotion are as follows: 1. A green industrial cluster, an integrated industrial chain and a database of local industry energy conservation and green development will be built in the demonstration provinces. 2. The advanced experience and technology, industrial standards and management system of green and low-carbon production will be summarized and refined. The local experience of this project demonstration areas will be piloted in other qualified areas such as the Yangtze River basin, and promoted to the whole country in due time, by establishing demonstration bases and organizing learning and training. 3. Introduce the practical results of this project, share China's experience in promoting industrial emission reduction and green development, through multilateral exchanges, new media technologies, and by cooperation with international organizations. 4. Demonstrate and drive the global cooperation in mineral resources development, taking the phosphorus chemical industry as a breakthrough point, promote the overseas practice of the implementation plan of China's energy conservation and low-carbon phosphorus chemical industry actively, give play to the spillover effect of knowledge and technology, and take the initiative to assume environmental and social responsibilities for outbound investment.

1b. *Project Map and Coordinates.* Please provide geo-referenced information and map where the project interventions will take place. Please see Annex A.

2. *Stakeholders.* Select the stakeholders that have participated in consultations during the project identification phase:

Indigenous Peoples and Local Communities;

Civil Society Organizations;

Private Sector Entities;

If None of the above, please explain why.

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| **Stakeholders** | **Respective roles in Project Preparation** |
| UNDP | As the implementing agency of GEF, it is responsible for project design, coordination, implementation, monitoring and management. |
| Ministry of Finance | As the communication authority with GEF in China, the Ministry of finance provides high-level strategic guidance and participates in project proposal endorsement |
| Ministry of Industry and Information Technology | Its core responsibility is to undertake the management of the phosphorus chemical industry, formulate and organize the implementation in energy conservation, greenhouse gas emission reduction, comprehensive resources utilization and clean production promotion policy and organize and coordinate the promotion and application of major green and low-carbon demonstration projects and new products, new technologies, new equipment and new materials. It is responsible for providing guidance for the design of low-carbon phosphorus chemical projects, working with the team to solve the main problems of the phosphorus chemical industry identified in the framework of this project, supporting the construction of national and provincial policy and institutional framework, participating in the whole project baseline activities and providing corresponding supporting funds, and responsible for the effective cooperation with UNDP, the Ministry of Finance and relevant departments in the energy conservation and emission reduction activities of phosphorus chemical industry Coordination and communication. |
| Ministry of Natural Resources | Its core responsibility is the management of low-carbon and efficient utilization of phosphorus resources production areas. The leading department of this project is the International Cooperation Department of the Ministry of Natural Resources. Responsible for providing guidance for the design of low-carbon phosphorus mine projects and, working with the project team to solve the main problems identified in the framework of this project, supporting the construction of national and provincial policy and institutional framework; clarifying its responsibilities, participating in the whole project baseline activities and providing corresponding supporting funds; and responsible for the effective coordination with UNDP, the Ministry of Finance and relevant departments in the phosphorus mine energy conservation and emission reduction activities and communication. |
| National Development and Reform Commission | In the preparation phase of this project, the NDRC participates in and guides the planning of this project to ensure that the output of the project can guide and encourage the participants of phosphorus resources development activities to promote the comprehensive utilization of phosphorus resources, and also put forward suggestions for the planning and policy measures of resource conservation and comprehensive utilization in China. |
| Ministry of Ecology and Environment | Participate in and guide the planning of this project during the preparation period to ensure that the project’s mechanism can provide intellectual support for China's participation in international climate change negotiations and the implementation of the United Nations Framework Convention on Climate Change. |
| Local governments, including Sichuan, Yunnan, Guizhou, etc. | The Provincial Department of natural resources (development and reform, industry and information technology, environment). Municipal and county-level governments directly participate in project design and baseline survey, provide technical support, guidance, and logistics support. During project implementation, provincial natural resources departments are responsible for supervising municipal and county-level work, including technical support, monitoring, supporting, coordination with partners, and capacity-building. |
| Relevant scientific research institutions[[8]](#footnote-8) | Provide suggestions and participate in project design, effectively incorporate, reflect and utilize national scientific knowledge to carry out research on energy saving and green low-carbon technology and low-carbon and high-efficiency comprehensive utilization technology of phosphorus resources in phosphorus chemical industry; relevant national and provincial scientific research institutions should clarify the current baseline knowledge, regarding to the implementation of the project and the coordination of the whole project with the national and provincial research projects. |
| Enterprises and private sector organizations[[9]](#footnote-9) | Low carbon and efficient comprehensive utilization of phosphorus resources, clean production of phosphorus chemical industry and low-carbon reuse of phosphogypsum involve technology R&D, production, and service enterprises. The participation of enterprises and the private sector in project design can ensure that this project is based on clear understanding of the marketization of by-products of comprehensive utilization of phosphorus resources. The design team should cooperate with the private sector to clarify the current by-products of comprehensive utilization market and supply-demand relationship, so as to further promote the establishment of relevant models; project consulting design should explore ways to involve private organizations in this project, evaluate the supporting potential, and support the promotion and sustainability of project achievements by the private sector. |
| Non-governmental organizations[[10]](#footnote-10) | Non-governmental organizations at national, provincial and local levels should also participate in the process of project consultation to ensure the utilization of this project and effective coordination with the activities and projects of non-governmental organizations; project design should also clarify the supporting facilities provided by non-governmental organizations, including community organizations, and clarify the ways of project achievements promotion and sustainability that local organizations participate in |

*3. Gender Equality and Women’s Empowerment.* Briefly include below any gender dimensions relevant to the project, and any plans to address gender in project design (e.g. gender analysis). Does the project expect to include any gender-responsive measures to address gender gaps or promote gender equality and women empowerment? yes  /no  / tbd  ; If possible, indicate in which results area(s) the project is expected to contribute to gender equality:

closing gender gaps in access to and control over natural resources;

improving women’s participation and decision-making; and/or

generating socio-economic benefits or services for women.

Will the project’s results framework or logical framework include gender-sensitive indicators? yes /no  / tbd

The early mining production environment was harsh, and the production process had strict requirements on the physical conditions of employees. As a result, the degree of participation and decision-making power of males and females in the mining industry were far more different than those in other production industries. Meanwhile, due to the influence of historical culture and traditional concept, there is the perspective of “son preference” in poor areas, and women lack opportunities for education and training, they cannot master the skills needed to participate in mining production.

This project will improve the production environment and automation degree of phosphorus industry, through the application of new technology and equipment. The physical strength requirements of work force in the production process will be reduced, and the appropriate conditions for women to participate in production and decision-making will be created. This project provides professional skills training for practitioners, by providing local women with opportunities for re-education and production skills training courses, to help women improve their skills and their adaptability in the production and decision-making activities of the phosphorus industry.

In addition, the socioeconomic level of this project demonstration area is underdeveloped, and the ecological environment is very fragile. The implementation of this project will effectively improve the ecological environment quality and directly improve the health conditions of women and children. Furthermore, the implementation of this project helps to guarantee agriculture and food security, reduce rural pollution and the threat of crop failure, reduce women's risk of income loss.

*4.* Private sector engagement*.* Will there be private sector engagement in the project? (yes  /no ). *Please briefly explain the rationale behind your answer.*

In China, most of the participants in the whole phosphorus industry chain are small and medium-sized enterprises, so in the whole process of project implementation, enterprises are the providers of technology, products, and services. Therefore, the private sector will participate in the construction of project demonstration sites in an all-round way and lay out a foundation for promoting this work in the country and even other countries in the future. The participation of the private sector in this project is mainly based on the following aspects:

First of all, private sector participation in energy conservation and green production is a more cost-effective way. Under the policy incentives, the private sector will explore the most cost-effective technologies for low-carbon mining of phosphate rock, energy-saving of phosphorus chemical industry and low-carbon recovery of phosphogypsum. Considering that the innovation power of traditional large-scale chemical state-owned enterprises under the economic incentive of energy-saving and green is lower than that of small and medium-sized enterprises, in this field, the private sector is often the pioneer of energy-saving and green technology innovation, and leads the development of the industry to achieve technological innovation. In addition, after the subsidy of phosphogypsum pretreatment technology, there are greater benefits and potential market returns in the field of phosphogypsum replacing cement, which enables the private sector to engage in phosphogypsum comprehensive utilization industry. Therefore, the private sector will use the most cost-effective way to achieve low-carbon emission reduction of phosphate rock, energy-saving and green production of phosphorus chemical industry, and comprehensive utilization of phosphogypsum under the economic subsidy provided by project funds and the information and technology exchange provided by the project’s organizer.

Secondly, the characteristics of the phosphorus chemical industry make it possible for China's private sector to participate in and dominate the industry. The phosphate rock production and phosphorus chemical industry mainly constitutes of small and medium-sized enterprises, which are limited to knowledge and fixed cost and use relatively backward production technology. The phosphorus chemical industry has many production links and chemical products, small and medium-sized enterprises who have wide business scope and appropriate scale become the backbone of the phosphorus chemical industry If policy incentives are provided for energy-saving, green production and comprehensive utilization of phosphogypsum, small and medium-sized enterprises will be encouraged to participate in market competition, which will help to ensure the establishment of phosphogypsum comprehensive utilization market and achieve market equilibrium.

Thirdly, the private sector has more competitive advantages and development potential in the field of energy conservation and green production of phosphate rock and phosphorus chemical industry and comprehensive utilization of phosphogypsum. The private sector's energy-saving and green production technology reform can bring economic income. Its technological innovation can also radiate to other enterprises in the industry, forming an industrial cluster of energy-saving and green production, which will have a positive impact on the technical reform of the whole industry. Through economic incentives, enterprises will explore energy-saving and green production technology and comprehensive utilization mechanism of phosphogypsum, which can stimulate the creativity of the private sector and lay a solid foundation for the vitality and sustainable development of the industry.

This project will select phosphorus industry chain enterprises in Yunnan, Guizhou, Sichuan, and Hubei regions to launch pilot projects, provide policy incentives and communication platform, and ensure the full participation of enterprises.

*5.* Risks.

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| **Potential Risks** | **Risk Level** | **Measures to Address Risks** |
| The project management office (PMO) cannot effectively organize and coordinate the participation of stakeholders (including relevant departments of local government, specific project implementation units, experts in various fields, etc.). | Medium | Preventive: The MIIT and MNR have adequate experiences in GEF project implementation, and have established long-term cooperative relationships with various ministries, local departments, industry related supporting units and relevant organizations, and can establish a scientific and efficient collaborative working mechanism to ensure the policy implementation of the project.  Alleviative: If coordination problems arise, the project team will have direct contact with the MNR and MIIT to ensure smooth coordination. Besides, investment from MIIT and MNR could facilitate building new program management team and increase management costs to ensure effective problem solving. |
| Coordination of the relationship between project objectives and the implementation of comprehensive utilization technology. | Low | Preventive: The MNR, MIIT and implementation units maintain close contact with relevant departments and can apply necessary adjustment promptly according to the adjustment of national policies, so as to ensure the implementation of this project and achieve the optimal effect.  Alleviative: Workshops shall be carried out on a regular basis to adjust project technology employment so that the overall goal will be achieved. |
| Unemployment caused by the reduction of cement production | High | Preventive: In the process of realizing green and low-carbon transformation of phosphorus chemical industry, the United Nations ‘2030 agenda for sustainable development’ was benchmarked to explore the formation of a multi-objective collaborative green development model to achieve ecological compensation, reduce poverty, improve ecological diversity, and ensure agricultural and food security. Focus on green employment action in the phosphorus chemical industry, improve the employment quality of the phosphorus chemical industry, create new employment growth points in the comprehensive utilization of phosphogypsum, and reduce the unemployment risk caused by industrial transformation.  Alleviative: Training programs should be carried out to relocate the unemployed to emerging industrial sectors from the project, i.e. renewable energy, phosphogypsum cleaning, waste water treatment, etc. |
| Allocated funds cannot support project implementation in time and in full | Medium | Preventive: Energy saving, green and low-carbon development and green mine construction are the important contents of China's ecological civilization goals, which make an important basis for guaranteeing supporting funds. The MNR and MIIT attach great importance to the implementation of this project, and provide relevant technology, resources, funds, and system support. Relevant project provinces will also make commitment to supporting funds for the project in the early stage of implementation. In the process of project design and implementation, it will continue to promote and attract the establishment of diversified financing modes including private enterprises to ensure the supporting funds are fully in place.  Alleviative: The project should explore new funding opportunities and create a market mechanism for cement replacement to ensure its financial sustainability. |
| Low level of commitment of stakeholders (including government agencies and PCI companies) in the implementation of project activities | Low-to-medium | Preventive: Policy regulations will be published to ensure stakeholders participate in the project. Market mechanism for phosphogypsum replacing cement will be established to encourage participation.  Alleviative: Incremental costs will be applied to increase subsidy for cement substitution and low-carbon mining technologies. |
| Difficulties in the replication of successful results of the project | Medium | Preventive: PMO will organize regional and national workshops to ensure timely spread of experience and knowledge. In these workshops other regions could share their difficulties and pilot projects could share their experiences.  Alleviative: Research and seminars will be carried out to identify the critical problems in replication and proper solutions. Supporting policies will be in place if necessary. |
| Availability of co-financing is delayed and negatively affects the implementation of the project activities | Low | Preventive: The MIIT and MNR will ensure that co-financing is timely in place.  Alleviative: If financing problems arise, the project team will have direct contact with the MNR and MIIT to ensure funding availability. |
| Varying vested interests and objectives of PCI companies as well as other stakeholders in the local and central governments may prevent the effective organization and coordination of their participation and support of the project | Low-to-Medium | Preventive: Policy as a regulative measure will be carried out to ensure PCI companies stick to the project, and financial support will be provided to companies to ensure their participation.  Alleviative: In regular workshops, companies could express their problems and find proper solutions when faced with difficulties. |
| The Project could lead to adverse impacts on enjoyment of the human rights (civil, political, economic, social, or cultural) of the affected population in the rural areas where the on-the-ground project activities will be carried out. | Low | Preventive: This project will be based in the underdeveloped western regions of Yunnan, Guizhou, Sichuan, and Hubei, and will focus on promoting the economic and social welfare of local enterprises and communities. The project will create employment opportunities and reduce poverty among the local communities through the upgrade of existing phosphate chemical industry including the integrated processing of phosphate chemical byproducts such as phosphogypsum. The design of the project will be extensively negotiated with local people and cooperate with relevant national and provincial government.  Alleviative: If adverse impacts occur, the MIIT and MNR will mobilize existing resources and experience to deal with harm on human rights. Workshops will be carried out to facilitate policymaking to make up for the affected population. |
| Potential adverse impacts to habitats (e.g. modified, natural, and critical habitats) and/or ecosystems and ecosystem services in some possible  changes to the use of lands and resources in the implementation of the demonstrations. | Medium | Preventive: The impacts related to construction activities are temporary and mostly reversible. The demos will involve the conduct of a detailed feasibility study on the local area before the demo implementation. The demos will be designed and constructed in accordance with international standards to ensure compliance with relevant environmental ordinances/regulations.  Alleviative: If adverse impacts occur, the MIIT and MNR will mobilize existing resources and experience to deal with harm on habitats. Workshops will be carried out to facilitate policymaking to conserve the affected landscape. |
| The associated construction, operation, or decommissioning of the demo installations may have potential health and safety risks to local communities due to the transport, storage, and use and/or disposal of any hazardous or dangerous materials (e.g. explosives, fuel and other chemicals) that may be used during construction and operation. | Low-to-medium | Preventive: Environmental Risk Assessment (ERA) will be conducted before project construction, which identifies the critical impact and solutions. ERA is valuable for insuring sound project construction and protecting local communities. The project will promote the application of new and advanced technologies for cleaner production, which are expected to reduce emissions, process wastes, effluents compared to the current processes. The demonstration component of the proposed project will be designed taking into consideration the need to prevent a potential for the release, in the environment, of hazardous materials resulting from their handling, storage and use for the demonstrations and replications that will be carried out under the project.  Appropriate training will be provided to the demonstration enterprises to ensure that they operate the installed system correctly and safely, and properly control and manage the release or disposal of waste. The project will minimize or avoid health risks and safety issues in the construction work of demonstration facilities in the project sites.  Alleviative: China is experienced in risk management and each area is guarded by a team of firefighters to ensure local safety in case accidents happen. Through demonstration projects, the project will minimize and manage the waste, effluents and emissions generated during project implementation |
| The project would potentially result in the generation of waste (non-hazardous). | Medium | Preventive: During the design and implementation of the project, strict environmental and social assessments will be conducted, and relevant recommendations will be made to reduce related environmental and safety risks.  The project will promote the application of new and advanced technologies for cleaner production, which are expected to reduce emissions, process wastes, effluents compared to the current processes. The demonstration component of the proposed project will be designed taking into consideration the need to prevent a potential for the release, in the environment, of hazardous materials resulting from their handling, storage and use for the demonstrations and replications that will be carried out under the project.  Alleviative: As the phosphate chemical industry is concentrated in Yunnan, Guizhou, Sichuan province, and other underdeveloped and ecologically fragile areas, the potential waste generation will be controlled and evaluated in the design and implementation stages. During operation, advanced waste disposal methods will be used to treat waste generated in the project to minimize the impact of waste on the environment. For example, solidification treatment of fluorine-containing waste and highly-charged heavy metal waste generated in the process of phosphogypsum reuse will minimize the impact of phosphate chemical waste on the environment. |
| Low local and international prices of phosrock and phosphate chemicals will discourage PCI companies to implement green, EE, and LC technology application projects | Medium | Preventive: MIIT and MNR will provide subsidies for green technologies and will carry out policies to favor companies in PCI with green technologies.  Alleviative: Subsidizing policies should be flexible in order to provide proper incentives when market prices fluctuate. |
| Extreme climate events in the project areas will negatively affect the implementation of the project activities | Medium | Preventive: Yunnan, Sichuan, Guizhou, and Hubei have higher risks of extreme weather, but they are therefore experienced in dealing with risks. Local governments shall strengthen their capacities to deal with extreme climate events in general. The project will also cover climate risk adaptation capacity building sector in technology training workshops.  Alleviative: Timely workshops will be organized in case of extreme climate events to find the proper adaptation means. |
| Extreme climate events in the project areas will delay and negatively affect the installation, operation and monitoring of the demonstration activities. | Low | Preventive: Yunnan, Sichuan, Guizhou, and Hubei have higher risks of extreme weather, but they are therefore experienced in dealing with risks. Local governments shall strengthen their capacities to deal with extreme climate events in general. The project will also cover climate risk adaptation capacity building sector in technology training workshops.  Alleviative: Timely workshops will be organized in case of extreme climate events to find the proper adaptation means. |

*6. Coordination.* *Outline the institutional structure of the project including monitoring and evaluation coordination at the project level. Describe possible coordination with other relevant GEF-financed projects and other initiatives.*

This project will set up a national project steering committee, a national project expert committee, a national project management office, establish a project implementation annual, middle, and final monitoring plan, hold various forms of project promotion coordination meetings, and organize annual work meeting.

The Ministry of Industry and Information Technology undertakes the administration of the chemical industry, participates in the formulation and implementation of policies on energy conservation and comprehensive utilization of resources, promotion of cleaner production and pollution control, and organizes and coordinates the promotion and application of major demonstration projects and new products, new technologies, new equipment and new materials. The Ministry of Natural Resources is responsible for the management of the phosphate industry and organizes the implementation of policies to promote the green and low-carbon development of the phosphate industry, with emphasis on promoting incentive policies and the formulation of relevant technical standards for the comprehensive utilization of phosphate tailings resources.

Collaboration will also be explored with other GOC entities, particularly those who working on low-carbon development of phosphorus industry chain. Such entities are expected to assist proponents of this project in the identification and analysis the barriers of the application of low-carbon technologies to support phosphorus industry. During the PPG stage, the development team will assess these projects (ongoing and planned) in the phosphorus industry for potential inclusion in the proposed project as baseline activities that the GEF project can build on. For example, as a demonstration, explore and consider potential synergies in the implementation of capacity development and promotional activities will be explored and considered between those funded/implemented by local and regional organizations and the ones envisioned under this proposed project.

*7. Consistency with National Priorities*. Is the project consistent with the National strategies and plans or reports and assessments under relevant conventions? (yes  /no  ). If yes, which ones and how:

-UNFCCC Related Technology Needs Assessment (TNA)

-UNCBD, UNFCCC, UNCCD National Capacity Assessment (NCSA)

-Poverty Reduction Strategy Paper (PRSP)

-UNFCCC Biennial Update Report (BUR)

-National Biodiversity Strategy and Action Plan (NBSAP)

-GEFSEC National Project Development Plan (NPFE)

**Alignment with national strategy/planning**

This project will explore a green and low-carbon sustainable development mode of the whole phosphorus industry chain in line with China's conditions, improve the energy efficiency of the industry, establish a phosphorus chemical circular economy mode, drive the green and low-carbon coordinated development of upstream and downstream enterprises, and minimize carbon emissions of the phosphorus chemical industry. This project is highly consistent with China's national strategic planning.

The relevant strategies, plans and policies of the Chinese government include:

**First, ecological civilization has been listed as a major strategy for China's national development.** The 19th National Congress of the Communist Party of China put the construction of ecological civilization in a prominent position, and clearly proposed to "accelerate the reform of ecological civilization system and build a beautiful China". It is required to implement the new development concept of innovation, coordination, green, openness and sharing, and accelerate the construction of a manufacturing power in China. It puts forward new and higher requirements for speeding up the implementation of green manufacturing, improving the utilization efficiency of resources and energy, and reducing environmental pollution.

**The second is to formulate and release relevant green development plans.** The Ministry of industry and information technology formulated and issued the 13th five year plan for industrial green development, which clearly required to accelerate the R&D and application of technology and application in the field of energy conservation and green development, and improve the level of process technology and equipment; it also required to build a green manufacturing system actively, accelerate the construction of green factories, development of green products, construction of green supply chain and construction of green parks.

**The third is the release and implementation of industrial upgrading and transformation related policies.** “The Guideline Catalogue for Industrial Restructuring (2019 Edition)” was released , in which the contents related to the green and low-carbon development of phosphorus chemical industry are put forward, such as the development and application of comprehensive utilization technology of phosphate ore dressing tailings, mining and utilization of medium and low grade phosphate ore, fluorite ore and barite, and comprehensive utilization of associated resources of phosphorite and fluorite ore, etc. “The implementation plan for special investigation and remediation of "three phosphorus" in the Yangtze River” was issued to focus on the pollution of "three phosphorus". The outline of “the 13th five year plan for national economic and social development” puts forward "promoting the conservation and intensive utilization of resources" and "vigorously promoting the construction of green mines and green mining development demonstration areas". Correspondingly, in the "leading action of circular development" jointly issued by the national development and Reform Commission and 14 departments, also proposed to "vigorously promote resource conservation and comprehensive utilization, and earnestly promote the construction of green mines and green mining development demonstration areas and improve guarantee capability of energy resources ".

**Alignment with GEF focus areas / strategies**

Through the construction and promotion of low-carbon green demonstration projects in the phosphorus chemical industry and the establishment of relevant standardization and specification system, this project aims to promote the establishment of complete energy-saving and green low-carbon production system in the phosphorus chemical industry, and make corresponding contributions to the national carbon emission reduction plan. This project is in line with the development goals set out in the “UN 2030 agenda for sustainable development”, including the promotion of persistent, inclusive, and sustainable economic growth, the promotion of full and productive employment and decent work for all, and the reduction of inequality within and among countries.

In this project, the construction and promotion of energy conservation and green low-carbon of China's phosphorus industry chain industry is consistent with the goal of accelerating energy efficiency and innovation and application of clean technology in the key area of planning document "climate change field" during GEF-7.

Women's participation will be taken into account in the implementation. This is consistent with the goals of UN sustainable development goals, such as poverty eradication, gender equality and empowerment of all women and children. It is also consistent with GEF's focus on women's equality.

Therefore, it is highly consistent with the focus area of GEF.

*8.* *Knowledge Management.*

During the implementation of this project, the knowledge management system will be used which includes the following aspects: Firstly, to carry out exchanges and cooperation between different regions and provide training for project participants. Secondly, to identify knowledge management activities through coordination with project stakeholders. Thirdly, special training will be given to relevant personnel to cultivate a group of professional leaders in the development of the phosphorus industry chain. These technical leaders will influence the process of knowledge management, which is of great significance to the implementation of this project and will play a positive role in promoting the development of the industry.

The first important output of this project in knowledge management is the establishment of a green and low carbon phosphate demonstration platform covering the whole industry chain. This platform will provide the basis for other areas of the key technologies to improve energy conservation. And carry out the optimization promotion, promote the demonstration project achievement promotion system, promote the green low carbon growth of phosphorus industry, combined with local resources endowment and current development situation. A second output is to form the green and low carbon phosphorus industry technical specification, standardization, and evaluation system. Promote industrial green and low-carbon technological reform and development of mining industry in other phosphate ore areas by establishing green and low-carbon standardization and evaluation system. The third output is to establish the construction plan and publicity plan of green and low carbon phosphorus industry, promote the advanced technology and successful practice in China, and help improve the green development capacity of the global phosphorus chemical industry including countries among the “Belt and Road” initiative. During the implementation of this project, we will draw on the experience from other projects related to industrial energy conservation and green development in WB, ADB and UNDP, summarize their successful practices and promote the project to create greater knowledge benefits.

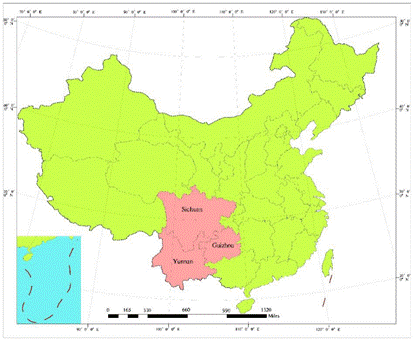
**part iii: approval/endorsement by gef operational focal point(s)**

A. Record of Endorsement of GEF Operational Focal Point (s) on Behalf of the Government(s): *(Please attach the Operational Focal Point endorsement letter(s) with this template. For SGP, use this SGP OFP endorsement letter).*

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Position** | **Ministry** | **Date** *(MM/dd/yyyy)* |
|  |  |  |  |

**Annex A: PROGRAM/PROJECT MAP AND GEOGRAPHIC COORDINATES**

**(when possible)**

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**Annex B: GEF 7 Core Indicator Worksheet**

*Use this Worksheet to compute those indicator values as required in Part I, item F to the extent applicable to your proposed project. Progress in programming against these targets for the project will be aggregated and reported at any time during the replenishment period. There is no need to complete this table for climate adaptation projects financed solely through LDCF and SCCF.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Core Indicator 6** | **Greenhouse gas emission mitigated** | | | | | | ***(Tons)*** |
|  | Tons (6.1+6.2) | | | | | |
| Entered | | | Entered | | |
| PIF stage | | Endorsement | MTR | | TE |
| Expected CO2e (direct) | 36,970,000\* | |  |  | |  |
| Expected CO2e (indirect) |  | |  |  | |  |
| Indicator 6.1 | Carbon sequestered or emissions avoided in the AFOLU sector | | | |  | |  |
|  | Million Tons | | | | | |
| Entered | | | | Entered | |
| PIF stage | | Endorsement | | MTR | TE |
| Expected CO2e (direct) | 220,000 | |  | |  |  |
| Expected CO2e (indirect) |  | |  | |  |  |
| Anticipated Year | 2022-2026 | |  | |  |  |
| Indicator 6.2 | Emissions avoided | | | | | |  |
|  | Hectares, has | | | | | |
| Expected | | | | Achieved | |
| PIF stage | | Endorsement | | MTR | TE |
| Expected CO2e (direct) | 36,750,000 | |  | |  |  |
| Expected CO2e (indirect) |  | |  | |  |  |
| Anticipated Year | 2022-2026 | |  | |  |  |
| Indicator 6.3 | Energy saved | | | | | |  |
|  | Energy Savings, MJ | | | | | |
| Expected | | | | Achieved | |
| PIF stage | | Endorsement | | MTR | TE |
| 1.73×1011 | |  | |  |  |
|  | |  | |  |  |
| Indicator 6.4 | Increase in installed renewable energy capacity per technology | | | | | |  |
| Technology | Capacity (MW) | | | | | |
| Expected | | | | Achieved | |
| PIF stage | | Endorsement | | MTR | TE |
|  |  | |  | |  |  |
|  |  | |  | |  |  |
|  |  | |  | |  |  |
|  |  | |  | |  |  |
|  |  | |  | |  |  |
| **Core Indicator 11** | **Number of direct beneficiaries disaggregated by gender as co-benefit of GEF investment** | | | | | | |
|  | |  |  | | Number Achieved | |
|  | PIF Stage | | MTR | TE |
| Female |  | |  |  |
| Male |  | |  |  |
| *Total* |  | |  |  |

\*During the five-year project implementation period

**Annex C: Project Taxonomy Worksheet**

*Use this Worksheet to list down the taxonomic information required under Part I, item G by ticking the most relevant keywords/ topics/themes that best describe this project.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Level 1** | **Level 2** | **Level 3** | **Level 4** |
| **Influencing models** |  |  |  |
|  | **Transform policy and regulatory environments** |  |  |
|  | **Strengthen institutional capacity and decision-making** |  |  |
|  | **Convene multi-stakeholder alliances** |  |  |
|  | **Demonstrate innovative approaches** |  |  |
|  | **Deploy innovative financial instruments** |  |  |
| **Stakeholders** |  |  |  |
|  | **Indigenous Peoples** |  |  |
|  | **Private Sector** |  |  |
|  |  | Capital providers |  |
|  |  | Financial intermediaries and market facilitators |  |
|  |  | Large corporations |  |
|  |  | SMEs |  |
|  |  | Individuals/Entrepreneurs |  |
|  |  | Non-Grant Pilot |  |
|  |  | Project Reflow |  |
|  | **Beneficiaries** |  |  |
|  | **Local Communities** |  |  |
|  | **Civil Society** |  |  |
|  |  | Community Based Organization |  |
|  |  | Non-Governmental Organization |  |
|  |  | Academia |  |
|  |  | Trade Unions and Workers Unions |  |
|  | **Type of Engagement** |  |  |
|  |  | Information Dissemination |  |
|  |  | Partnership |  |
|  |  | Consultation |  |
|  |  | Participation |  |
|  | **Communications** |  |  |
|  |  | Awareness Raising |  |
|  |  | Education |  |
|  |  | Public Campaigns |  |
|  |  | Behavior Change |  |
| **Capacity, Knowledge and Research** |  |  |  |
|  | **Enabling Activities** |  |  |
|  | **Capacity Development** |  |  |
|  | **Knowledge Generation and Exchange** |  |  |
|  | **Targeted Research** |  |  |
|  | **Stakeholder Engagement Plan** |  |  |
| **Gender Equality** |  |  |  |
|  | **Gender Mainstreaming** |  |  |
|  |  | Beneficiaries |  |
|  |  | Women groups |  |
|  |  | Sex-disaggregated indicators |  |
|  |  | Gender-sensitive indicators |  |
| **Focal Areas/Theme** |  |  |  |
|  | **Climate Change** |  |  |
|  |  | **Climate Change Mitigation** |  |
|  |  |  | Agriculture, Forestry, and other Land Use |
|  |  |  | Energy Efficiency |
|  |  |  | Sustainable Urban Systems and Transport |
|  |  |  | Technology Transfer |
|  |  |  | Renewable Energy |
|  |  |  | Financing |
|  |  |  | Enabling Activities |
|  |  | **Climate Finance (Rio Markers)** |  |
|  |  |  | Climate Change Mitigation 1 |
|  |  |  | Climate Change Mitigation 2 |
|  |  |  | Climate Change Adaptation 1 |
|  |  |  | Climate Change Adaptation 2 |

**Annex D: GHG Emission Reduction Estimates**

The project consists of 3 components, focusing on: (1) low carbon phosphate rock mining and refining; (2) low carbon phosphate chemicals production; and (3) phosphate chemicals production waste management. The energy savings and GHG emission reductions from this project will be derived (directly and indirectly) from the activities that will be carried out in each of these components of the project. The estimates are based on available statistical data from the PCI in China including production volumes and average energy consumption.

In phosphate rock mining in China the average energy consumption per ton of raw phosrock is 1.94 kgce (kilograms of standard coal), while that in the beneficiation process is 7.93 kgce. The project envisions an energy saving rate of 15% in the mining process and 10% in the beneficiation process. Additionally, the improvement of mining efficiency (including improving mine recovery rate, mining dilution rate, and beneficiation recovery rate) can achieve a reduction of 0.987 kgce per ton of output. The envisioned low carbon mining demo under the proposed project is about 10 million tons (Mt). For that production rate, the estimated energy saving in phosphate mining would be about:

6.07×108 MJ/yr. × (10 Mt/yr. × (1.94 kgce/t × 15% + 7.93 kgce/t × 10% + 0.987kgce/t) × 29.3076 MJ/kgce = 6.07×108MJ/yr.).

Considering a typical emission factor of 2.62 tons of CO2 per tce, the estimated emission reduction is about:

0.05 Mt CO2e/yr. × (10 Mt/yr. × (1.94 kgce/t × 15% + 7.93 kgce/t) × 10% + 0.987kgce/t) ×2.62 tCO2/tce = 0.05MtCO2e/yr.

In phosphate chemicals production in China, the energy consumption per unit of phosphate chemical products is 504 kgce, which is expected to reduce by 5% because of the proposed project. It is envisioned that the demo activities under the project will be for a production capacity of phosphate chemicals of about 18.20 Mt/yr. In this regard, the estimated energy saving in phosphate chemicals production is about:

1.34×1010 MJ/yr. × (18.20 Mt/yr. × 504 kgce/t × 5% × 29.3076 MJ/kgce = 1.34×1010MJ/yr.), and the estimated GHG emission reduction is about:

1.19 MtCO2/yr. × (18.20 Mt/yr. × 504 kgce/t × 5% × 2.62 tCO2/tce = 1.19 MtCO2/yr.

The activities on low-carbon waste management systems in the PCI will be carried out in: (1) phosphate chemicals production; (2) phosrock mining and refining. The first one is on the utilization of phosphogypsum in cement clinker production, at a rate of 1 ton phosphogypsum per ton cement clinker to produce a new type of cement. It is envisioned that under the project, the demo activity on phosphogypsum production is about 69 Mt/yr. The specific energy consumption in the traditional cement production is 0.07 tce/t, while for the new cement production it is 0.01tce/t. The estimated annual energy saving in the phosphogypsum utilization is about:

9.71×109MJ × (69 Mt/yr. × 8% × (0.07 tce/t - 0.01tce/t) × 29.31MJ/kgce =9.71×109MJ/yr.).

The carbon emission coefficient of traditional and new cement production is 1.1 tCO2/t and 0.2 tCO2/t, respectively. Hence, it is estimated that about:

4.97 MtCO2 × (69 Mt/yr. × 8% × (1.1 tCO2/t - 0.2 tCO2/t) = 4.97 MtCO2e/yr. GHG emission reduction will be achieved through the use of phosphogypsum in the cement production.

Another potential GHG emission reduction action that will be demonstrated is the utilization of phosrock mine tailings to produce biological phosphate fertilizer as replacement for the use of phosphate fertilizer, thus reducing the energy consumption and carbon emissions in the production of phosphate fertilizers. It is estimated that the pure nutrient (P2O5) content of biological phosphate fertilizer products is 16%, and the specific energy consumption of phosphate fertilizer production is 0.636 tce/t P2O5. The envisioned demonstration would process a phosrock tailing of about 3.63 Mt/yr., and in this case, the use of tailings as an alternative raw material for phosphate fertilizer production will bring about an annual energy saving of about:

1.08×1010MJ × (3.63 Mt/yr. × 0.636 tce/tP2O5 × 16%) × 29.31 MJ/kgce = 1.08×1010 MJ/yr.

The corresponding GHG emission reduction is about:

0.96 MtCO2e/yr. × (3.63 Mt/yr. × 0.636 tce/tP2O5 × 16% × 2.6 tCO2/tce) = 0.96 MtCO2/yr.

In addition, ecological restoration of phosphate mines can achieve 1,000 hectares of afforestation. It is estimated that 1 hectare of forest trees can achieve carbon sequestration of 1.01 tCO2 per day, and the conversion coefficient of carbon sequestration efficiency within five years of non-adult forest trees is 60%. Therefore, the envisioned ecological restoration demo under the project can achieve carbon sequestration of about:

0.22 MtCO2/yr. × (1000 ha. × 1.01 tCO2/(ha. \* d) × 60% = 0.22 MtCO2e/yr.

In summary, the proposed project is estimated to bring about an energy saving of 3.46×1010 MJ/yr. and a reduction of CO2 emissions by about 7.39 MtCO2/yr. By end of the 5-year project, the estimated cumulative energy saving is about 1.73×1011 MJ and the cumulative GHG emission reduction is about 36.97 MtCO2.

1. This include results of the assessment of the environmental impacts on the upper reaches of the Yangtze River of the green, energy efficient low carbon technology application demos in the partner phosrock mines located in the lower reaches of Jinsha River and the Central Yunnan Basin. [↑](#footnote-ref-1)
2. This MRV system will also be used for the demonstrations of green, energy efficient low carbon technologies/techniques and practices in phosrock mining and refining, phosphate chemical manufacturing, and by-product processing. It will also be used in the MRV of any replication and scale-up of the demos during and after the GEF project lifetime. [↑](#footnote-ref-2)
3. The demonstrations will be on the application of new technologies and equipment for phosrock mining and refining, improved resource utilization and waste reduction schemes, and improved processing and utilization technologies for phosrock waste and tailings in central Yunnan, including mine reclamation to improve the ecological environment of the mining area. [↑](#footnote-ref-3)
4. The demonstrations will be carried out in partner phosphate chemical companies in Yunnan, Guizhou, Sichuan, and Hubei, including the companies in the supply chains of the demo companies. Included in the demo is the application of the green (ecological) design (new and retrofit) design of phosphate chemical manufacturing processes. [↑](#footnote-ref-4)
5. Includes Yunnan Phosphate Group, Guizhou Wengfu Group, Sichuan Huarui Mining Co., Ltd., Sichuan Ruifeng Mining Co., Ltd., China blue Changhua Engineering Co., Ltd., Wengfu (Group) Co., Ltd., Guizhou Kailin group mineral fertilizer Co., Ltd. [↑](#footnote-ref-5)
6. See Annex D. [↑](#footnote-ref-6)
7. This may include the demonstration of cleaner production schemes, energy efficiency technology measures, application of improved production processes that are more energy efficient, less polluting and improve productivity, application of schemes that will reduce process losses and waste generation and application of circular economy models in phosphate chemical production. [↑](#footnote-ref-7)
8. Includes Chinese Academy of Social Sciences, Institute of Mineral Resources Multi⁃Utilization of China Geological Survey, Sichuan University, Kunming University of science and technology, Guizhou Academy of Sciences and Wuhan University of Engineering, etc. [↑](#footnote-ref-8)
9. Includes Yunnan Phosphate Group, Guizhou Wengfu Group, Sichuan Huarui Mining Co., Ltd., Sichuan Ruifeng Mining Co., Ltd., China blue Changhua Engineering Co., Ltd., Wengfu (Group) Co., Ltd., Guizhou Kailin group mineral fertilizer Co., Ltd. [↑](#footnote-ref-9)
10. Includes The Chemical Industry and Engineering Society of China, China Petroleum and Chemical Industry Federation, China chemical energy conservation technology association, China Phosphate and Compound Fertilizer Industry Association, local mining associations. [↑](#footnote-ref-10)