Facilitating Cleaner and Energy Efficient Phosphate Chemicals Industry in China (PhosChemEE) Project

Environmental and Social Impact Assessment Report

July, 2024

CONTENTS

List of Acronyms

ACWF	All-China Women's Federation
CISIA	China Inorganic Salts Industry Association
DPE	Demonstration Project Enterprise
GEF	Global Environment Facility
GHG	Greenhouse Gas
GM	Grievance Mechanism
IP	Implementing Partner
IPCC	The United Nations Intergovernmental Panel on Climate Change
LCA	Life Cycle Assessment
LMP	Labour Management Procedure
MIIT	Ministry of Industry and Information Technology
MNR	Ministry of Natural Resources
MOF	Ministry of Finance
NDRC	National Development and Reform Commission
PCI	Phosphate Chemical Industry
PMO	Project Management Office
PSC	Project Steering Committee
SES	Social and Environmental Standards
UNDP	United Nations Development Programme

1. Executive Summary

The PhosChemEE project aims to eliminate barriers to the promotion and deployment of energy-saving and green low-carbon technologies in the phosphate chemical industry, to facilitate the widespread application of these technologies in China's phosphate chemical industry, to reduce greenhouse gas emissions from the industry, and to promote the transformation towards energy-saving and green development in the phosphate chemical sector, thereby contributing to the achievement of the "dual carbon" goals. The PhosChemEE project implements demonstration activities in provinces such as Yunnan, Guizhou, and Sichuan, selecting six demonstration project companies, which are: (1) Guizhou Wengfu (Group) Co., Ltd.; (2) Sichuan Development Tianrui Mining Co., Ltd.; (3) Guizhou Kailin Mining and Fertilizer Co., Ltd.; (4) Yunnan Phosphate Chemical Group Co., Ltd.; (5) Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.; (6) Zhonglicheng Industrial Co., Ltd..

This report first outlines the national legislation, policies, regulations, international agreements, and treaties related to the project, as well as the social and environmental standards of the United Nations Development Programme (UNDP). It then introduces the main objectives of the project and provides an overview of the socio-economic and environmental baseline data of the six demonstration projects. By collecting and analyzing preliminary work documents such as environmental impact assessment reports and feasibility study reports of the six projects, the report assesses the environmental and social impacts of the project.

These six demonstration projects involve the green and low-carbon development and operation of phosphate mines, the green and low-carbon design and operation of phosphate chemical production facilities, and the operation of green and low-carbon design and waste management systems in the phosphate chemical industry. Overall, the project's social and environmental risks are controllable, and it has a positive effect on the environment and greenhouse gas reduction. The main environmental and social risks include:

In terms of biodiversity/natural habitat protection threats, the focus is mainly on the upstream phosphate mining development phase, as it is open-pit mined, which may have an impact on the ecological environment in the construction area or along the pipeline route. For example, the Fuling project in Guizhou has a phosphate concentrate pipeline

and return water pipeline passing through the Shuijin Valley scenic area, and if the phosphate concentrate pipeline leaks, it will cause damage to the shrubs and trees along the pipeline route, soil pollution within the pollution range will damage the vegetation in the forestland, and ultimately affect the ecological environment along the pipeline route. In contrast, the middle and lower reaches of phosphoric acid production and the comprehensive utilization of phosphogypsum and yellow phosphorus tail gas projects are concentrated in industrial parks, and the location of the selected area has no special ecologically sensitive areas, so the significant water bodies that pose a threat to biodiversity/natural habitats protection are generally lower.

In terms of pollution and waste discharge, the main focus is on sudden environmental accidents in water pollution and soil pollution. Specifically, the phosphate mining development projects in the upstream area are at risk of pipeline rupture and tailings dam failure, which will cause pollution to surface water, groundwater and soil to some extent. The middle-stream phosphate production and downstream phosphogypsum and tails gas utilization projects are all concentratedly planned in industrial parks, and the overall environmental risk level of pollution and waste discharge under normal operation is relatively low.

In addition, in terms of climate change, the six demonstration sites of the PhosChemEE project involve the efficient utilization of tailings, resource recovery, and phosphate chemical technology upgrading, which have good environmental performance in terms of greenhouse gas emissions reduction, but will also result in additional energy consumption due to the use of new technologies, causing direct or indirect greenhouse gas emissions.

The overall social risk level of the PhosChemEE project is "low," but some key social risks need to be vigilant. The first is that the project construction involves a small number of migrants, although the original residents have been properly accommodated under the united planning and leadership of the local government, the employment problem of the migrant relocation households will still have an impact. The second is that in the participation of the female group, the demonstration project enterprises generally do not provide more information disclosure on the recruitment, salary, and employment of women, and it is currently difficult to accurately judge gender discrimination problems. It still needs further research and monitoring of the impact of related issues, including the equal participation of men and women in employment,

training, environmental risk management, and policy formulation. Three are the risks of natural disasters or sudden events, such as landslides caused by heavy rains, pipeline leaks, tailings dam failures, and the risks of toxic, flammable, and harmful substances leaking from chemicals used in the projects, which may affect the surrounding community residents, employees of the demonstration project enterprises.

Although the 6 demonstration projects have certain environmental and social risks, on the whole, all 6 projects have adopted advanced production technologies and strictly implemented environmental and social impact standards. Compared with the baseline scenario, which uses the current technology and environmental and social standards in the region, they have great environmental and social benefits. The phosphate recovery rate at the Wengfu phosphate mine project reached 96.84%, the water reuse rate was 95.0%, 5769.4 tons per year of phosphorus was recovered (calculated based on P_2O_5), 2,429,300 m^3 per year of fresh water was saved, and 3,200 t of sulfuric acid was saved, with an estimated direct economic benefit of 42 million RMB per year. The annual stable increase in revenue from the Tianrui project in Mabian County, equivalent to reducing the consumption of 4.2 million tons of original ore resources. The wastewater at Guizhou Keping Phosphate was fully recycled and not discharged. Yunnan Phosphate Chemical Group Co., Ltd. has carried out industrial application transformation to reduce the P_2O_5 grade of flotation tailings from 7% to 6%, achieving a reduction of P_2O_5 grade in flotation tailings to below 6%, an increase in the recovery rate of concentrates by 1.5%, and the recovery of at least 90,000 tons of concentrates per year, a reduction of 90,000 tons of tailings discharge per year, and a reduction of raw ore extraction by about 130,000 tons per year. Yunnan Xiangfeng Environmental Protection Technology Co., Ltd. has the advantages of rapid recovery of water-soluble phosphorus, reducing phosphorus loss; improving the quality of cement retarder to meet user needs; extending the storage period of slag heap to reduce the operating costs of slag heap; reducing the amount of gypsum extracted, lowering extraction costs; reducing natural water consumption, making it easy to control the system's water balance; and reducing the annual emissions of particulate matter by 60 tons, sulfur dioxide by 1,250 tons, nitrogen oxides by 153 tons, and other air pollutants, all of which can be reduced and meet emission standards. In terms of greenhouse gas emissions, six projects can reduce carbon dioxide emissions by 702,000 tons. In terms of social benefits, the six projects have important promoting effects on the economic and social development of the local

area.

To avoid or mitigate potential negative environmental and social impacts, the following suggestions are made: In terms of environmental risks, environmental pollution prevention and control measures can be formulated, energy resource utilization efficiency can be improved, and greenhouse gas emission levels can be reduced. In terms of social risks, improvements can be made by raising the living standards of local residents, strengthening care and support for women, establishing emergency response plans for sudden events, and increasing public participation in project construction.

This report outlines the project's stakeholders, clarifies the regulations and standards for their active participation, and the complaint and correction mechanism. Detailed stakeholder participation and monitoring plans are provided in the ESMP.

2. Legal and Institutional Framework

2.1 National Legislation, Policies and Regulations

2.1.1 General Environmental Protection

"Carbon dioxide emissions are aimed to reach a peak before 2030 and strive to achieve carbon neutrality by 2060." The "Dual Carbon" goals of the People's Republic of China are highly consistent with the energy-saving and cleaner production objectives established by this project.

The "Environmental Protection Law (2015)" is the strictest environmental law passed in China, emphasizing the protection of nature. In its purpose, the law incorporates "ecological civilization construction" and declares environmental protection as a "basic national policy." The state adopts economic, technological policies, and measures that are conducive to saving and recycling resources, protecting and improving the environment, and promoting harmonious coexistence between humans and nature, making economic and social development coordinated with environmental protection. Specifically, Article 36 stipulates that the state encourages and guides citizens, legal persons, and other organizations to use products and recycling products that are beneficial to environmental protection, reducing the generation of waste; Article 40 stipulates that the state promotes cleaner production and resource recycling. The implementation of the PhosChemEE project must comply with this law at all times.

The "Environmental Impact Assessment Law" (2003, revised in 2018 for the second time) aims to implement the sustainable development strategy, prevent adverse environmental impacts after the planning and construction of projects, and promote the coordinated development of economy, society, and environment. The law stipulates two types of EIA: environmental impact assessments for planning and for construction projects. For projects that have an impact on the environment within the territory and other maritime areas under the jurisdiction of the People's Republic of China, EIA shall be conducted in accordance with this law. Specifically, for projects that may cause significant environmental impacts, an environmental impact report shall be prepared for a comprehensive EIA; for projects that may cause minor environmental impacts, an environmental impact report form shall be prepared for EIA or a special assessment; for projects with minimal environmental impact and no need for EIA, an environmental impact registration form shall be submitted. The EIA classification management catalog for construction projects is formulated and published by the competent department of ecology and environment under the State Council. Article 21 of the law stipulates: for construction projects that may have a significant impact on the environment and shall prepare an environmental impact report, the construction unit shall hold a forum, hearing, or take other forms to solicit opinions from relevant units, experts, and the public before submitting the environmental impact report for approval. The environmental impact report submitted by the construction unit shall include an explanation of whether the opinions of relevant units, experts, and the public are adopted or not. PhosChemEE will fall within the scope stipulated by this law.

The "Cleaner Production Promotion Law" (2003, revised in 2012) stipulates in Articles 4 and 6 that the state encourages and promotes cleaner production and related scientific research, technological development, and international cooperation, organizes publicity and popularization of cleaner production knowledge, and promotes cleaner production technology. To promote cleaner production, the law provides regulations on financial support and information system construction; Article 16 of the law points out that people's governments at all levels should prioritize the purchase of products that are beneficial to environmental and resource protection, such as energy-saving, water-saving, and waste recycling. In the implementation of cleaner production, there are corresponding legal provisions for industries, agriculture, and services, especially Article 25 of the law, which points out that the exploration and mining of mineral

resources should adopt exploration and mining methods and technological processes that are conducive to the rational use of resources, environmental protection, and pollution prevention, and improve the level of resource utilization.

The "Circular Economy Promotion Law" (2009) is a law formulated to promote the development of the circular economy, improve resource utilization efficiency, protect and improve the environment, and achieve sustainable development. Article 16 of the law proposes that the state shall implement a key supervision system for energy consumption and water consumption for key enterprises in industries such as steel, non-ferrous metals, and chemicals that exceed the total national quota. Article 22 of the law stipulates that the mining of mineral resources should be planned comprehensively, a reasonable development and utilization plan should be formulated, and a reasonable mining sequence, method, and mineral processing technology should be adopted. The mining permit issuing authority should review the mining recovery rate, mining dilution rate, mineral processing recovery rate, mine water recycling utilization rate, and land reclamation rate in the development and utilization plan submitted by the applicant; if the review is not qualified, the mining permit shall not be issued. The mining permit issuing authority should strengthen the supervision and management of mining mineral resources in accordance with the law.

Overall, China's general environmental protection legal framework is relatively complete, providing clear legal basis and norms for project implementation; projects that may have an impact on the environment should be evaluated and public opinions should be sought. The PhosChemEE project should work in accordance with environmental protection requirements to ensure the sustainable development of the ecological environment.

2.1.2 Legislation Related to Air, Water and Noise Standards

The "Air Pollution Prevention and Control Law of the People's Republic of China" (revised in 2018) aims to protect and improve the environment, prevent air pollution, ensure public health, promote ecological civilization, and sustainable economic and social development. The law stipulates that the competent departments of ecology and environment under the people's governments at or above the county level shall implement unified supervision and management of air pollution prevention and control. Other relevant departments under the people's governments at or above the county level shall supervise and manage air pollution prevention and control within their respective

responsibilities. Specifically, Articles 43 and 48 of the law state that enterprises in industries such as steel and chemicals, which emit dust, sulfur compounds, and nitrogen oxides during production, should adopt clean production processes; strengthen refined management, and take centralized collection and treatment measures to strictly control the emission of dust and gaseous pollutants. This aligns with the PhosChemEE project's pursuit of higher environmental protection standards.

The "Noise Pollution Prevention and Control Law of the People's Republic of China (2022)" aims to prevent and control environmental noise pollution, protect and improve the living environment, and ensure human health. It stipulates that local people's governments at all levels shall be responsible for the sound environmental quality within their administrative regions and take effective measures to improve the sound environment quality. The emission of noise and vibration should comply with noise emission standards, environmental vibration control standards, and relevant laws, regulations, and rules. Additionally, local people's governments at or above the county level should optimize the layout of industrial enterprises according to planning requirements to prevent industrial noise pollution. During the construction and operation of the PhosChemEE project, noise pollution may be generated from some production equipment, mechanical operations, and transportation vehicles, but such noise activities are generally controllable.

The "Water Pollution Prevention and Control Law of the People's Republic of China" (revised in 2017) aims to protect and improve the environment, prevent water pollution, protect aquatic ecology, ensure the safety of drinking water, maintain public health, promote the construction of ecological civilization, and sustainable economic and social development. The law stipulates that the discharge of water pollutants shall not exceed national or local water pollution discharge standards and the total control indicators for key water pollutants. Article 21 of the law states that enterprises, institutions, and other operators that directly or indirectly discharge industrial wastewater, medical wastewater, and other wastewater that should obtain a pollution discharge permit according to regulations, shall obtain a pollution discharge permit. The second section of the law sets forth regulations on industrial water pollution prevention and control, stating that relevant departments of the State Council and local people's governments at or above the county level should plan the industrial layout reasonably, require enterprises causing water pollution to carry out technological transformations,

adopt comprehensive prevention and control measures, improve the reuse rate of water, and reduce the discharge of wastewater and pollutants.

Overall, based on the relevant information, the PhosChemEE project does not involve large-scale infrastructure construction projects that may cause significant air, water, and noise pollution in the planning stage. During the construction and operation phases, there is no significant potential negative impact on community health and safety due to noise, air pollution, and diseases.

2.1.3 Land Rights

China has a long history of formulating and implementing laws and regulations related to relocation and resettlement. The "National Construction Land Expropriation Measures" issued in 1953 were the first regulations in China regarding land expropriation and resettlement. These measures stipulated the principles and procedures for land expropriation and the standards for compensation payment, which became the foundation for the later "Land Administration Law."

The "Land Administration Law of the People's Republic of China" (amended in 2019) states in Article 2 that China practices a socialist land ownership system, which includes state ownership and collective ownership by working people. State ownership refers to the ownership of state-owned land exercised by the State Council on behalf of the nation. Urban land is state-owned. Land in rural and suburban areas, except for that legally designated as state-owned, belongs to the collective ownership of farmers. Article 63 indicates that for collective construction land designated for industrial, commercial, and other business purposes in the overall land use planning and urban and rural planning, and registered according to law, the landowner may transfer or lease the land to units or individuals for use. A written contract should be signed, specifying the land boundaries, area, start date of construction, duration of use, land use, planning conditions, and other rights and obligations of both parties.

In summary, the PhosChemEE project must legally expropriate and obtain land use rights according to regulations. If the project significantly affects land resources and the environment without undergoing a legal environmental impact assessment or without implementing corresponding environmental protection measures according to the assessment results, it may violate the relevant provisions of the Land Administration Law.

2.1.4 Legislation Related to Community Health and Working Conditions

The right to a safe and healthy working environment for workers is the right of workers to protect their physical and mental health from harm caused by working conditions. The "Labor Contract Law of the People's Republic of China" (revised in 2012) stipulates that employers who have one of the following circumstances shall be subject to administrative penalties according to law: if a crime is constituted, criminal responsibility shall be pursued according to law; if damages are caused to workers, they shall bear compensation liability.

2.1.5 Legislation Related to Energy Development and Transition

The "Energy Conservation Law" (1998, revised in 2018) stipulates that conserving resources is a fundamental national policy of China. This law establishes a set of energy-saving legal documents, including energy management and technological progress. Article 7 mentions that the state encourages and supports the development and utilization of new and renewable energy sources. For rural areas, Article 59 stipulates that people's governments at the county level and above should strengthen energy-saving work in agriculture and rural areas according to the principles of adapting to local conditions, complementing various energy sources, comprehensive utilization, and seeking benefits, and increase investment in the promotion and application of energy-saving technologies and products in agriculture and rural areas.

To promote the development and utilization of renewable energy, increase energy supply, optimize the energy structure, ensure energy security, protect the environment, and achieve sustainable economic and social development, the "Renewable Energy Law (2016)" was formulated. Article 18 stipulates that the state encourages and supports the development and utilization of renewable energy in rural areas. Energy management departments of local people's governments at the county level and above should develop rural renewable energy development plans in conjunction with relevant departments according to the actual situation of local economic and social development, ecological protection, and comprehensive health management, and promote the application of technologies such as biogas conversion for home solar energy, small wind energy, and small hydro energy.

The "Energy Development Strategy Action Plan (2014-2020)" adheres to the strategic principles of "conservation, cleanliness, and safety," accelerating the construction of a clean, efficient, safe, and sustainable modern energy system, and focusing on implementing four strategies. The first is the conservation priority strategy

(energy-intensive and efficient development, scientific and reasonable use, and greatly improving energy utilization efficiency); the second is the domestic-oriented strategy; the third is the green and low-carbon strategy (optimizing the energy structure, taking the development of clean and low-carbon energy as the main direction for adjusting the energy structure); and the fourth is the innovation-driven strategy (strengthening the construction of the energy technology innovation system, relying on major projects to promote scientific and technological innovation, and building a strong energy technology country).

In addition, to achieve the goal of a non-fossil energy consumption share of about 25% by 2030 and a total installed capacity of wind and solar power of over 1.2 billion kilowatts, to implement the "carbon peak, carbon neutrality" goals, to consolidate and enhance the competitiveness of the renewable energy industry, and to basically build a clean, low-carbon, and efficient energy system, the National Development and Reform Commission, the National Energy Administration, and other nine departments jointly issued the "14th Five-Year Plan for Renewable Energy Development (2022)." The plan points out the need to raise green energy requirements in industries, construction, transportation, and public institutions.

Since the promulgation of the "Renewable Energy Law" (2016), the central National Development and Reform Commission, various construction departments, and local provinces have successively introduced relevant policies, forming a policy framework for renewable energy development centered on the "Renewable Energy Law," which also covers target planning, fiscal and financial measures, electricity price control, and consumption guarantee policies. Some policies, such as the "Interim Measures for the Management of Special Funds for Renewable Energy Development" (2015), "Renewable Energy Industry Catalog" (2005), and the "Notice on Establishing a 'Guarantee Mechanism' for Renewable Energy Consumption" (2019), have been implemented nationwide. Others, set by the central government with localities arranging their own timetables and standards, include the "Interim Measures for the Administration of Renewable Energy Electricity Price and Cost Sharing" (2006), "Interim Measures for the Distribution of Income from Renewable Energy Electricity Price Surcharges" (2007), "Regulations on the Administration of Renewable Energy Power Generation" (2006), and others. The "Measures for the Full Guarantee of Renewable Energy Power Generation Purchase" (2015) and the "Pilot Measures for the

Priority Generation of Renewable Energy Peaking Units (2016)" have also been established.

2.1.6 Regulations and Policies Related to Mineral Resource Exploitation

(1) The "Mineral Resources Law" (1986, revised in 2023) aims to promote high-quality development in the mining industry, ensure the security of national mineral resources, facilitate the rational development and utilization of mineral resources, strengthen the protection of mineral resources, safeguard the rights and interests of the state as the owner of mineral resources and the legal rights of mining rights holders, advance the construction of ecological civilization, and meet the needs of comprehensively building a modern socialist country. Article 52 of the Law states that the natural resources authorities and other relevant departments under the people's governments at the county level and above should, in accordance with their responsibilities, strengthen the supervision and inspection of activities such as mineral resource exploration, mining, and mine ecological restoration, and promptly investigate and punish illegal activities (timely investigate and deal with illegal activities according to the law). In addition, the State Council of the People's Republic of China has formulated the "Implementation Rules of the Mineral Resources Law" based on the "Mineral Resources Law," which clearly stipulates the registration of mineral resource exploration, approval of mining, and related legal responsibilities.

(2) To promote the construction of "green mines" and encourage energy saving and emission reduction in phosphate mining, in 2017, the Ministry of Land and Resources of the People's Republic of China, the Ministry of Finance, the Ministry of Environmental Protection, the General Administration of Quality Supervision, Inspection and Quarantine, the China Banking Regulatory Commission, and the China Securities Regulatory Commission jointly issued the "Guiding Opinions on Accelerating the Construction of Green Mines." It requires that all newly built mines must meet the requirements of green mine construction, making green mines an important direction for their development. The "China Mineral Resources Report (2023)" points out that by the end of 2022, more than 1,100 national-level green mines had been built. In June 2023, the "Notice on Carrying Out the Spot Check and Verification of Green Mines in 2023" (Natural Resources Office Letter [2023] No. 1017) was issued, requiring the implementation of normal supervision based on "looking back" and conducting spot checks and verifications on green mines included in the national, provincial, and

municipal lists, with a verification ratio of no less than 20%. In addition, in 2019, the Office of the Ministry of Natural Resources issued the "Notice on Updating the Catalog of Advanced and Applicable Technologies for the Conservation and Comprehensive Utilization of Mineral Resources," requiring the selection and comprehensive demonstration of 334 technologies from the first six batches from 2012 to 2017, and the completion of provincial-level natural resources authorities' recommended technological progress. A total of 360 technologies were selected, including 19 phosphate mine development technologies.

(3) The phosphate industry has policy guidance and constraints in the field of environmental protection and energy conservation. In December 2023, the "Implementation Plan for Promoting the Efficient and High-Value Utilization of Phosphate Resources" proposed that by 2026, China's sustainable guarantee capacity for phosphate resources will be significantly enhanced, the independent innovation capability and green safety level of phosphate chemical industry will be steadily improved, the supply capacity of high-end phosphate chemicals will be greatly increased, regional complementary advantages and linkage development capabilities will be continuously strengthened, and the resilience and safety level of the industrial chain and supply chain will be more stable. The plan has set specific development goals from four aspects: innovation-driven, structural optimization, green development, and ecological cultivation. One of the measures in the plan is to promote the conservation and utilization of phosphate resources and improve the "three rates" of phosphate mining. In 2019, the Ministry of Ecology and Environment successively issued the "Implementation Plan for the Special Inspection and Rectification of 'Three Phosphorus' Pollution in the Yangtze River Basin" and the "Technical Guidelines for the Special Inspection and Rectification of 'Three Phosphorus' Pollution in the Yangtze River Basin," which identified phosphate mines, phosphate fertilizers, and phosphogypsum warehouses as the "three focuses" of the special inspection and rectification action, and proposed five key inspection and rectification objects (phosphate mines, phosphate fertilizers, phosphorus-containing pesticides, yellow phosphorus, and phosphogypsum warehouses).

(4) The Chinese government has gradually paid attention to the treatment and disposal of phosphogypsum. In 2011, MIIT issued the "Guiding Opinions on the Comprehensive Utilization of Industrial Byproduct Gypsum," improving the tax

preferential policies for the use of industrial byproduct gypsum as a retarder in cement production, and guiding enterprises to use industrial byproduct gypsum as a cement retarder. Local governments have gradually paid attention to the comprehensive utilization of phosphogypsum. In 2017, Guizhou Province formulated a special plan for the development of phosphogypsum industry, implementing the "production based on use" for phosphogypsum. Governments in Hubei, Sichuan, Yunnan, and other places have successively introduced policies to promote the low-carbon transformation (PCI) and green transformation of the phosphate chemical industry in their provinces.

For example, the "Hubei Province Phosphogypsum Pollution Prevention and Control Regulations" (2022) is the first local regulation in China on phosphogypsum pollution prevention and control, providing legal protection for strengthening phosphogypsum pollution prevention and control, promoting the comprehensive utilization of phosphogypsum and the high-quality development of the phosphate chemical industry. The "Yunnan Province '14th Five-Year' Ecological Environment Protection Plan" clearly focuses on tailings and associated minerals, coal gangue, fly ash, phosphogypsum, etc., to build a demonstration base for the comprehensive utilization of bulk solid waste, promote a significant increase in the level of comprehensive utilization of bulk industrial solid waste, carry out the investigation and rectification of informal solid waste storage sites, and strengthen the support and guarantee role of the system, technology, market, and regulatory systems for the disposal and utilization of solid waste. The "Yunnan Province '14th Five-Year' Plan for the Prevention and Control of Industrial Solid Waste and Heavy Metal Pollution" clearly proposes to strictly implement the comprehensive utilization technology and product standards for tailings, fly ash, slag, industrial byproduct gypsum, and other industrial solid waste, and standardize the development of the industrial solid waste comprehensive utilization industry. The plan indicates to expand the utilization channels of phosphogypsum, continue to promote the use of phosphogypsum in the production of cement and new building materials, and explore the application of phosphogypsum in soil improvement, ecological restoration, road base materials, and other fields under the premise of ensuring environmental safety. It encourages cement, brick, and other building material enterprises to prioritize the use of phosphogypsum, steel slag, slag, red mud, and other industrial solid waste as alternative raw materials, and improve the comprehensive utilization rate of industrial solid waste. The "Yunnan Province Solid Waste Pollution

Environmental Protection Regulations (Draft)" proposes in Article 28 that "industrial byproduct gypsum enterprises should expand the channels of comprehensive utilization, and phosphogypsum should 'reduce the increase and decrease the storage' under the premise of ensuring environmental safety, and increase its application in the production of cement, new building materials, ecological utilization, and other fields."

In 2021, the Ministry of Industry and Information Technology of the People's Republic of China issued the "Green Industrial Development Plan for the '14th Five-Year'" (MIIT Regulation [2021] No. 178), which proposes to take the promotion of high-quality development as the theme, supply-side structural reform as the main line, carbon peak and carbon neutrality goals as the lead, and the coordinated effect of pollution reduction and carbon reduction as the general grasp, to coordinate development and green and low-carbon transformation, deeply implement green manufacturing, accelerate the optimization and upgrading of industrial structure, vigorously promote industrial energy saving and carbon reduction, and comprehensively improve resource utilization efficiency. The plan clearly points out that it is necessary to promote the circular transformation of resource utilization and strengthen the efficient and collaborative utilization of primary resources such as phosphate and non-ferrous metals.

(5) The technical requirements for phosphate mines and phosphate chemical industry are constantly improving. In October 2019, the State Administration for Market Regulation and other parties released the "Technical Specifications for the Treatment and Disposal of Phosphorus Tailings" (GB/T38104—2019), which applies to the treatment and disposal of phosphorus tailings generated by the phosphate chemical industry, stipulates the treatment and disposal methods of phosphorus tailings and environmental protection requirements, and provides technical guarantees for the standardized treatment and disposal of phosphorus tailings. In addition, in August 2019, the Ministry of Industry and Information Technology of the People's Republic of China promulgated the "Technical Specifications for Phosphate Ore Mining and Dressing Residue" (HG/T 5524—2019), which clarifies the main process conditions for phosphate ore mining slag and dressing slag, providing the main regulatory basis for phosphate ore mining enterprises and environmental resource management agencies for slag discharge.

2.1.7 Regulatory and Compliance Institutions

The environmental and safety regulatory and compliance authorities that provide permits and approvals for project implementation and monitoring mainly include the Ministry of Industry and Information Technology (MIIT), the Ministry of Natural Resources (MNR), the Ministry of Finance (MOF), the National Development and Reform Commission (NDRC), the Ministry of Ecology and Environment (MEE), and the provincial, municipal, and county governments in the demonstration project area. The roles and responsibilities of the compliance authorities are described in Section 7.2, Stakeholder Analysis.

2.2 International Agreements and Treaties

2.2.1 Environmental Protection

In 2016, the Paris Agreement officially came into effect, with China being one of the parties to the agreement. The PhosChemEE project may lead to the emission of a large amount of greenhouse gases (such as carbon dioxide, methane, nitrous oxide, etc.) during its implementation. If these emissions exceed the limits set by national or regional regulations and the agreement, it could violate the emission reduction targets of the Paris Agreement. The PhosChemEE project should take effective measures to improve energy efficiency and adhere to the principles of sustainable energy and low-carbon economy advocated in the agreement.

The Montreal Protocol on Substances that Deplete the Ozone Layer is a United Nations agreement aimed at preventing the continued degradation and damage to the Earth's ozone layer caused by chlorofluorocarbons in industrial products, continuing the broad principles of the 1985 Vienna Convention for the Protection of the Ozone Layer. The convention has been in effect since January 1, 1989. The PhosChemEE project should review its production processes to ensure that it does not use or produce substances prohibited or restricted by the Montreal Protocol.

Additionally, the World Charter for Nature, adopted by the United Nations General Assembly on October 28, 1982, is a global programmatic document for nature conservation. The charter encourages the conduct of environmental impact assessments before undertaking activities that may significantly affect the environment. The Declaration on the Human Environment, adopted in 1972, aims to establish principles for environmental protection and sustainable development. The Nairobi Declaration, adopted in 1982, and the Rio Declaration on Environment and Development, adopted in

1992, both advocate for cleaner and more energy-efficient production.

2.2.2 Biological Conservation

The Convention on Biological Diversity is an international convention aimed at protecting the Earth's biological resources. The convention officially came into effect for China in December 1993. During the implementation of the PhosChemEE project, there may be impacts on the local ecosystem.

2.2.3 International Agreements and Treaties Relating to Chemicals

The "Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal" (Basel Convention) aims to prevent the transboundary movement of hazardous wastes, particularly the export and transfer of such wastes to developing countries. China signed the Convention on March 22, 1990. During the implementation of the PhosChemEE project, hazardous wastes such as wastewater, slag, or exhaust gases may be generated, which need to be handled by waste treatment units that have undergone thorough review.

The "Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade" came into effect on February 24, 2004. Its purpose is to protect human health, including the health of consumers and workers, and the environment from the potential harmful effects of certain hazardous chemicals and pesticides in international trade. If the chemicals produced in the PhosChemEE project are to be exported, they should be properly labeled and identified.

The "Stockholm Convention on Persistent Organic Pollutants" came into effect on May 17, 2004, and became effective in China on November 11, 2004. The Convention aims to protect human health and the environment from persistent organic pollutants (POPs). The PhosChemEE project should strictly adhere to the Convention's restrictions on the use of 12 POPs and provide regular reports on the production, use, and emission of POPs, as well as the proper treatment and disposal of waste containing POPs.

2.3 UNDP’s Social and Environmental Standards

The PhosChemEE project aligns with the United Nations Development Programme's (UNDP) Social and Environmental Standards (SES), which came into effect on January 1, 2015, and were updated on January 1, 2021. These standards form the foundation of UNDP's commitment to integrating social and environmental sustainability into its programs and projects in support of sustainable development. They

are also an integral part of UNDP's quality assurance and risk management methodology. Through SES, UNDP meets the environmental and social safeguard policies required by the Global Environment Facility (GEF).

The objectives of SES are to: enhance the social and environmental outcomes of programs and projects; avoid adverse impacts on humans and the environment; minimize, mitigate, and manage adverse impacts when they cannot be avoided; strengthen the capacity of UNDP and its partners to manage social and environmental risks; and ensure full and effective participation of stakeholders, including the establishment of mechanisms to respond to complaints from affected communities.

According to the UNDP SES policy, the Social and Environmental Screening Procedure (SESP) has been applied to the PhosChemEE project during the project development phase. Based on UNDP's SES policy, potential risks that are assessed as "moderate," "substantial," or "high" based on their likelihood and degree of impact trigger the SES principles or standards; risks assessed as "low" do not trigger the relevant principles or standards. For the PhosChemEE project, the screening conducted during the project development phase indicated that all social and environmental standards have been triggered due to "high," "substantial," or "moderate" risks, as detailed in Table 2-1 and Table 2-2.

Table2-1 PhosChemEE project SES triggers

Principles/ Standards	Trigger
Principle 1: Human Rights	Due to the potential risks faced by workers during the project implementation process, such as safety, health, working hours, and remuneration, as well as the impact of industrial development on the livelihoods of indigenous peoples.
Principle 2: Gender Equality and Women's Empowerment	Due to potential gender differences in employment conditions and the workplace within the project.
Principle 3: Accountability	Due to the production and handling of chemicals involved in the project, which may pose potential risks of environmental pollution, safety production and disasters, and chemical management.
Standard 1: Biodiversity Conservation and Sustainable Natural Resource Management	Due to possible changes in the use of land and resources during the project implementation process.

Standard 2: Climate Change and Disaster Risks	Due to the potential generation of greenhouse gases during the project implementation process.
Standard 3: Community Health, Safety and Security	Due to the health and safety risks to local communities from the transportation, storage, use, and/or disposal of any harmful or dangerous materials.
Standard 4: Cultural Heritage	Due to the potential transformation, demolition, or reconstruction of facilities during the implementation process, which may have historical and cultural value, and the project site may be located in communities with unique traditions, lifestyles, and cultural characteristics.
Standard 5: Displacement and Resettlement	The construction of the project may involve the expropriation of land, which could force local residents to leave their land and face the risk of displacement.
Standard 6: Indigenous Peoples	The project involves respect, rights protection, and cultural protection for indigenous groups during the implementation process.
Standard 7: Labour and Working Conditions	The project requires the hiring of employees during the implementation process.
Standard 8: Pollution Prevention and Resource Efficiency	Due to the potential generation of waste during the construction and operation of RE/EE devices.

Table 2-2 PhosChemEE Project risk screening table

General principle / Project level standard	Risk rating
Principle 1: Human Rights	High
Principle 2: Gender Equality and Women's Empowerment	High
Principle 3: Accountability	High
Principle 4: Sustainability and Resilience	
Standard 1: Biodiversity Conservation and Sustainable Natural Resource Management	Substantial
Standard 2: Climate Change and Disaster Risks	Substantial
Standard 3: Community Health, Safety and Security	Substantial
Standard 4: Cultural Heritage	Substantial
Standard 5: Displacement and Resettlement	Moderate
Standard 6: Indigenous Peoples	High
Standard 7: Labour and Working Conditions	Substantial
Standard 8: Pollution Prevention and Resource Efficiency	Substantial
The number of risks in each risk rating category	

High	1
Substantial	5
Moderate	3
Low	-

2.4 Gap Analysis

2.4.1 Analysis of China's Policy Framework

The contradictions and deficiencies within China's regulatory framework mainly include:

(1) There is a lack of specific laws for the implementation process of phosphate mines and phosphate chemical industry. As indicated in 2.1.6, the development and processing of phosphate mines and tailings, as well as phosphate chemical industry, are only addressed at the technical level, and there are no clear targeted regulations and policies, which may restrict the further development of the phosphate chemical industry.

(2) The legislative authority in the field of clean and energy-saving production of mineral resources is low. As shown in 2.1.6, the current Chinese regulations on clean and energy-saving production in the development and processing of mineral resources are still mainly based on "implementation opinions" and "guidelines," which are less authoritative than laws and lack sufficient enforcement and regulatory mechanisms, leading to some enterprises not fulfilling their responsibilities for clean and energy-saving production.

(3) The cross-departmental coordination and overall planning effect of policies need to be strengthened. Since the development and processing of mineral resources involve multiple fields, including geological exploration, mineral resource development, and environmental protection, it is necessary to further strengthen cross-departmental coordination mechanisms to ensure the connection and coordinated advancement of policies in different fields, avoiding policy fragmentation and conflicts between departments.

(4) Current laws and policies focus on the regulation and constraints during the implementation process, with insufficient support for technological innovation and research and development. A few documents, such as the "Notice on Updating the Catalog of Advanced and Applicable Technologies for the Conservation and Comprehensive Utilization of Mineral Resources," propose timely updates to mineral resource development technologies, but policies that incentivize the research and

development of clean and energy-saving production technologies are still rare.

(5) Local policies need to be updated. Current relevant policies, legislation, and regulations are mainly concentrated at the national level. For the implementation of specific projects, local regulations should be formulated in line with local realities, taking into account factors such as regional resource endowment, industrial structure, and environmental carrying capacity. In addition, some local policies may have insufficient enforcement and inadequate enterprise supervision, necessitating strengthened supervision and assessment mechanisms for local policy implementation.

2.4.2 Analysis of The Gap between Project and Policy Standards

Compared with the environmental and social security policies of UNDP SES and the relevant policies and laws of the Chinese government, the gaps are analyzed as follows:

(1) The formulation of environmental emission standards is lagging behind, and the phosphorus chemical industry policy needs to be refined. The phosphorus chemical industry chain includes phosphorus ore mining, phosphorus ore beneficiation, phosphate production, phosphorus fertilizer production, etc., for the treatment of emissions in the process is key. However, as can be seen from section 2.1.6 of the report, the earliest local regulations on phosphogypsum pollution prevention and control (Hubei) were issued in 2022, and the implementation area of the project, including Guizhou, Sichuan, and Yunnan, issued special action programs and other documents to treat and prevent waste generated by the phosphorus chemical industry in April 2022, August 2023, and October 2023 respectively, which is far behind the start of the project. The time lag is far behind the start of this project. Prior to this time, China only had policies on industrial solid waste and heavy metal pollution prevention and control, whose emission and treatment standards could not meet the new types of waste that may be brought about by the adoption of new technologies, production methods or recycling methods in the course of project implementation.

(2) Energy consumption and energy conservation standards. As can be seen from Section 2.1.5, current policies and regulations are mainly focused on encouraging enterprises to adopt energy-saving production methods, which lack quantitative energy-saving targets, assessment mechanisms, and monitoring and reporting requirements for energy consumption by enterprises. In addition, enterprises need to comply with national energy consumption and energy conservation regulations and

policies, including the Energy Conservation Law and other relevant laws and regulations. However, in practice, Some enterprises may have problems such as insufficient understanding of policies and regulations and inadequate implementation, resulting in a certain gap between energy consumption and energy saving and the requirements of the policy standards.

(3) Resource utilization standards. On the one hand, as can be seen from the Cleaner Production Promotion Law and Circular Economy Promotion Law mentioned in section 2.1.1 of the report, the current policy encourages enterprises to improve the efficiency of resource utilization, however, as the actual resource utilization of enterprises is not specified in the policy, there may be a large degree of freedom in the actual operation of enterprises, and it is difficult to quantify and assess the specifics of resource utilization. For example, the feasibility report of the Tianrui project did not propose the resource utilization rate in the course of the project. On the other hand, the current policy standards may be too limited to individual enterprises or segments, and lack a comprehensive consideration of the resource utilization of the entire phosphorus chemical industry chain. The phosphorus chemical industry chain involves a number of links and participants, and the policy standards may fail to take into full consideration the flow of resources and utilization efficiency between the various links, leading to the loss and waste of resources in the industry chain.

3. Project Background

3.1 Overall Situation

The PhosChemEE Project aims to solve problems mentioned above through enabling the extensive application and best practices of low carbon and energy efficient technologies in the phosphate chemicals industry in China. The social and environmental objectives of the PhosChemEE Project are:

(1) Establish effective policy and institutional frameworks towards the development of cleaner and energy efficient phosphate chemicals industry in China.

(2) Improve interest and commitment of the phosphate chemical industry in the green, low carbon and energy efficient operations of the PCI industries in China.

(3) Enhance confidence in the feasibility of the application of green, energy efficient low carbon technologies in the PCI industries in China.

(4) Improve the environment in underdeveloped western regions, especially by reducing greenhouse gas emissions (GHG) and improving the quality of local ecological

environment.

(5) Strengthen public awareness, knowledge, information management, and monitoring systems on greening and low carbon transformation in support of cleaner and energy efficient phosphate chemicals industry in China.

The project consists of three components:

(1) Green and low carbon development and operation of phosphate mines.

(2) Green and low carbon design and operation of phosphate chemicals production facilities.

(3) Green and low carbon design and operation of waste management systems in the phosphate chemicals industry.

The PhosChemEE project is implemented by the United Nations Development Programme (UNDP) as the international executing agency, with the Ministry of Industry and Information Technology (MIIT) as the Implementing Partner and the Ministry of Natural Resources (MNR) as the Responsible Party. The project carries out demonstration activities in provinces such as Yunnan, Guizhou, and Sichuan, selecting six demonstration project companies across three parts, which are: (1) Guizhou Wengfu (Group) Co., Ltd; (2) Sichuan Development Tianrui Mining Co., Ltd.; (3) Guizhou Kailin Mining and Fertilizer Co., Ltd.; (4) Yunnan Phosphate Chemical Group Co., Ltd.; (5) Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.; (6) Zhonglicheng Industrial Co., Ltd. Considering the geographical location of the sites, it is expected that there will be no cross-regional impacts.

Table 3-1 Project composition and Expected outcomes

Project composition	Expected outcomes	Demonstration project	province	Recommending department
Green and low carbon development and operation of phosphate mines	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; Enhanced confidence in the feasibility of the application of green, energy efficient low carbon technologies in phosrock mining and refining in China.	Application of Full Tailings Filling Technology in Underground Phosphate Mines	Guizhou	MNR
		Intelligent Device and Application of Mixed Acid Preparation for Phosphorus Float Selection	Sichuan	MNR

Green and low carbon design and operation of phosphate chemicals production facilities	Established a green and low-carbon development model for phosphorus chemicals; Enhanced confidence in the feasibility of the application of green, energy efficient low carbon technologies in phosphate chemicals production in China.	Application of advanced purification technology to produce high-purity wet purification of phosphoric acid	Guizhou	MIIT
Green and low carbon design and operation of waste management systems in the phosphate chemicals industry	Enhanced commitment of, and institutional and technical arrangements for, the phosphate chemical industry in green and low carbon waste management; 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.	Multi-purpose large-scale processing and utilization of phosphate chemical wastes	Yunnan	MNR
		Phosphogypsum Production of Composite Fillers Project	Yunnan	MIIT
		Recovery and utilization of yellow phosphorus tail gas for power generation project	Sichuan	MIIT

3.2 Demonstration Project Overview

3.2.1 Application of Full Tailings Filling Technology in Underground Phosphate Mines

(1) Status of demonstration projects

Implementation entity: Guizhou Wengfu (Group) Co., Ltd

Construction location: Wengfu phosphate Mine, Fuquan City, Guizhou Province.

Guizhou Wengfu (Group) Co., Ltd is one of the five largest phosphate fertilizer bases in China, which was constructed by the state during the Eighth and Ninth Five-Year Plan Periods in order to guarantee national food security and fill the gaps of high-concentration phosphorus compound fertilizer in China. After more than 30 years of construction and development, the company has become a large-scale state-owned enterprise integrating phosphate mining, phosphorus compound fertilizer, fine PCI, sulfur and coal chemical industry, fluorine and iodine chemical industry, construction and building materials, scientific and technological research and development, trade and logistics, engineering and technical services, modern agricultural industry, and environmental protection technology output. The company is a national innovative enterprise, national high-tech enterprise, with the industry's only national key laboratory for the efficient utilization of medium and low-grade phosphate ore and its co-associated resources. There are 2 national and 10 provincial and ministerial technology innovation

platforms, such as post-doctoral research workstation and state-level enterprise technology center. The company's "Microchemical Technology and Application of High-Value Wet-Process Phosphoric Acid and Clean Production" won the Second Prize of the 2019 National Science and Technology Progress Award, and it is the industry's first large-scale complete set of wet purification phosphoric acid process technology owner and the industry's largest product supplier, as well as the world's first enterprise that has mastered the technology of recovering fluorine and iodine strategic resources from the process of phosphorus chemical production, and carrying out deep processing. The company has won the China Industry Award, Guizhou Governor's Quality Award and other honors, and its wet purified phosphoric acid products and anhydrous hydrogen fluoride products have won the title of National Manufacturing Industry Champion Products. With a registered capital of 4.609 billion RMB, more than 6,000 employees and more than 50 subsidiaries at all levels, the company has formed four major production and R&D bases with Fuquan, Guizhou as the core and Jinchang, Gansu, Dazhou, Sichuan and Shanghang, Fujian as the support, with 8.5 million tons of phosphorus ore mining, 3.12 million tons of phosphorus fertilizers, 2.73 million tons of chemicals and the corresponding production capacity of phosphorus gypsum products that can be eliminated by 2 million tons per year.

Wengfu phosphate mine is a modern mining and processing joint production unit under the umbrella of Wengfu (group), is one of China's five major phosphorus production bases, started in 1990, completed in 1995, is the national "Eighth Five-Year Plan" key construction projects. At present, the mine has an annual production capacity of 8.5 million tons of phosphate rock and 5 million tons of phosphate concentrate.

Datang mine belongs to the production unit of Wengfu phosphorus mine, Datang mine section of the resource reserves of 9003.48 million tons, the design mining capacity of 1 million tons per year, the use of trackless ramps underground car transportation, mining method selection of large-diameter deep-hole stage of the empty field after the subsequent filling mining method, filling and elimination of tailings 400,000 tons per year, filling the consumption of 75,000 tons of cement per year, the use of gravel for 150,000 tons per year.

Before the demonstration project, Datang Mine used sand and gravel plus tailings filling method to carry out underground mining, and the main ways to generate carbon emissions include transportation of sand and gravel, crushing, screening, tailings

transportation, cement consumption and energy consumed in the mining process, which consumes 14,778.5 tons of standard coal and generates 38,424.1 tons of carbon dioxide per year. In view of the actual situation of Datang Mine's filling mining, the demonstration project proposes to adopt two main ways to realize the purpose of energy saving and consumption reduction. One is to adopt the whole tailings filling, in place of the sand and gravel processing process and its supporting equipment and facilities; the other is to carry out research on the filling cementitious material, reducing the amount of cement (the filling cementitious material of Datang Mine is cement, and the production of cement produces relatively high carbon emissions). Through the application of the preliminary research results of Datang Mine, the reduction of carbon emissions has been gradually realized since 2020, and the two results of cancelling the sand and gravel processing technology and using ultra-fine powder (yellow phosphorus slag grinding and utilizing) to replace part of the cement for filling can realize the annual reduction of carbon emissions of more than 6,173t.

The annual ore production capacity of the whole mine is 8.5 million tons, and the designed mining methods are all tailing filling mining methods. After all the mines are transferred to underground mining, it is expected that 3.4 million tons of tailings will be filled and utilized.

(2) Implementation content

1) Datang Mine tailing filling station

The sand and gravel filling station is transformed into a complete tailings filling station, the sand and gravel transportation, crushing, screening and other processes are canceled, the tailings dehydration and the full tailings loading and metering system are added, and the filling pump and filling and mixing equipment were upgraded.

Sand and stone processing site renovation: The crushing and transshipment equipment of the original sand and gravel processing site is removed, the transport vehicle is cancelled, and the site is cleaned up, and the site is flattened and hardened, and the facilities such as rain and sewage diversion ditch, sewage collection tank, sewage sedimentation tank, and high water tank are built, the tailings dewatering plant is constructed, the tailings dewatering equipment and facilities are purchased and installed, the whole tail loading system, the metering system, etc., and the filling pump and mixing equipment are upgraded.

The 50%-55% concentration tailings slurry formed by beneficiation is transported

to the tailings storage tank of the filling station through pipelines, and part of the tailings are dehydrated to form 80%-90% concentration dry tailings. The dry tailings are transported to the mixing tank through the tailings charging system, while the other part of the tail pulp is also transported to the mixing tank and the cementing material is stirred to meet the design concentration of the tail pulp for filling.

The filling cementing material in Datang mine mainly uses cement, which accounts for more than 60% of the filling cost and has high carbon emission. In this paper, the cement substitute based on ultrafine powder (yellow phosphorus slag grinding) was used as filling cementing material to reduce the cement consumption and recycle the yellow phosphorus slag.

Table 3-2 Project implementation technical plan

Step	Concrete proposal
Laboratory Investigation	In the laboratory, the filling stone was prepared by the cementation material composed of different proportions of ultrafine powder and cement and the tailings, and the standard maintenance, stripping and pressure detection were carried out to form a laboratory report of the filling body, summarizing its basic conditions such as strength, slump, leaching toxicity and settlement.
Commercial Test	The laboratory research results are carried out in industrial experiments, suitable goaf is selected for filling, and natural maintenance is carried out after filling. A sewage collection pond is built at the bottom of the filling area for water filling and filtration treatment, and the filling body is drilled for strength and other indicators to test, verify the laboratory results, and be promoted and applied after meeting the design requirements.
Popularization and Application	After the success of the full-tail filling mining technology in Datang Mine, the results will be applied to the mines in the districts of Daxin, Yingping, Milli and other Wengfu phosphate mines, and then the strength and leaching toxicity of the filling body core sampling will be tracked.

2) Daxin full tailing filling station

The sand and gravel filling station is transformed into a whole tailings filling station with expanded capacity. Process such as the sand and gravel transportation, crushing, screening and other processes are cancelled. Instead, tailings dehydration and the whole tailings charging and metering system are added, and the filling pump and filling and mixing equipment are upgraded.

3) Yingping full tailing filling station

New facilities include tailings buffer storage and mixing, dewatering, charging and metering systems, filling pumps, filling and mixing equipment, as well as water treatment facilities.

4) Mill full tailing filling station

New facilities include new tailings buffer storage and mixing facilities, new

tailings dewatering facilities, new tailings charging and metering systems, new filling pumps and filling and mixing equipment facilities, new water treatment facilities.

5) Tailings pond

After the implementation of the full tailing filling mining technology, the tailing pulp is fully consumed and utilized through the mining capacity, beneficiation capacity, tailings production rate and other ways in the area of Wengfu phosphate Mine, so as to achieve the condition of balanced mining, beneficiation and charging, and the existing Baiyan tailings pond is no longer used, and the new Xiaowengguang tailings pond is no longer built.

(3) Implementation plan

The subproject of Datang Mine tailing filling Station in 2022 has been completed and put into use; Through the good carbon reduction effect achieved by the completion and use of Datang Mine filling station, the expansion and reconstruction sub-project of Daxin Full tailing filling station, Yingping full tailing filling Station and Mill full tailing filling station have been completed in 2023, among which Daxin full tailing filling station has been put into use, and it is expected that Yingping full tailing filling station and Mill full tailing filling station will be put into use successively in 2024. It is expected to realize the closure of Baiyan tailings pond in 2024.

Table 3-3 Project implementation schedule

Duration	implementation plan	Main contents and arrangement	Investment budget (ten thousand RMB)
2022	Carry out the whole tail filling reform, filling cementing material research and the whole tail filling industrial test in Datang Mine.	In October 2022, the whole tail filling reform of Datang Mine will be completed, and the research on filling cementing materials and the industrial test of the whole tail filling will be completed.	580 yuan
2023	The capacity expansion of Daxin full-tail filling station was carried out.	In May 2023, the capacity expansion of Daxin full-tail filling will be completed, and the full-tail filling work will be carried out.	1,700 yuan
2024	Carry out the construction of Yingping full-tail filling station, carry out the construction of mill mine full-tailings filling station, and carry out the closure of Baiyan tailings pond.	The construction of Yingping full-tail filling station will be completed in October 2024, and the construction of mill full-tail filling station will be completed in December 2024 to realize zero tailing of Baiyan tailings pond.	36,671 yuan
2025	The tailing filling work of Datang Mine, Daxin mine, Yingping mine and mill mine	In the first quarter of 2025, the full tailing filling test and production of Yingping and Mill underground	0 yuan

	has been carried out.	will be completed, and the balance of mining and filling will be completed in December 2025 to achieve the established goal.	

3.2.2 Intelligent Device and Application of Mixed Acid Preparation for Phosphorus Float Selection

(1) Status of demonstration projects

Implementation entity: Sichuan Development Tianrui Mining Co., Ltd.

Construction location: Tongchanggeng (No. 8 ore block) phosphate mine, Laoheba phosphate mine area, Mabian Yi Autonomous County, Leshan City, Sichuan Province.

Sichuan Development Tianrui Mining Co., Ltd. is a wholly-owned state-owned enterprise under Sichuan Development (Holding) Group Co., Ltd. was founded in 2008, mainly engaged in phosphate rock shaft mining, ground beneficiation, tailings filling, concentrate sales, mine design mining scale of 2.5 million tons per year, beneficiation design production scale of 2 million tons per year, phosphorus concentrates are all supplied to the Sichuan Development Longyi Co. Ltd. as raw material for phosphorus chemical production.

Sichuan Development Tianrui Mining Co., Ltd. is located in Mabian County, Leshan City, Sichuan Province, where there are abundant phosphate resources, the original properties of the mine is a gum phosphate ore, mainly phosphate composition, containing a small amount of Si, Al, Fe, K, Mg and other elements, of which the average content of Mg0 is about 5-8%, so the local processing plant are used in the removal of magnesium to increase the phosphorus, a single reverse flotation process.

The existing beneficiation system of Tianrui Mining Plant adopts single reverse flotation, magnesium and phosphorus removal and beneficiation process, and the system flow includes two closed-circuit crushing of raw ore, two closed-circuit ball milling, two sweeps of flotation for one coarse and one fine, thickening of concentrate tailing, dewatering of concentrate, and tailing charging. Among them, the flotation process is the core part of the beneficiation process, which is the focus and difficulty of beneficiation research, as well as the key point and breakthrough point for improving quality and efficiency, energy saving and consumption reduction.

At present, the beneficiation chemicals in Tianrui Mining's processing plant are mainly "sulfuric acid + saponin-based" trapping agents, with sulfuric acid consumption of 28 kg per ton (raw ore); trapping agent consumption of 0.9kg per ton (raw ore); and

concentrates power consumption of 69.9kWh per ton, which is a high-energy consumption that leads to high carbon emissions. The main problems include: large consumption of sulfuric acid, beneficiation costs account for about half of the production costs of beneficiation, high beneficiation costs; high phosphorus content in the tailings, which does not maximize the use of resources; easy to scale in the overflow area, blocking the slurry channel, which affects the continuous production system and is difficult to clean up; the acid mist produced when diluted with concentrated sulfuric acid and the odor spilled after mixed with pulp are large, which has a great impact on the field operators and equipment.

(2) Implementation content

1) Advance publicity and promotion. Publicize and promote the Global Environment Facility's "China PCI Chain Energy Saving and Green Low Carbon Enhancement" demonstration project to boost the morale of scientific researchers and technicians.

2) Project research and development. Building upon the traditional phosphorus ore separation process, efforts are directed towards addressing challenges such as difficulties in separating low-grade phosphorus ore, high energy consumption, and low resource utilization. These challenges are explored and researched theoretically, and processes are tested and summarized to examine the advantages and disadvantages of mixed-acid beneficiation. This research supports the design of the project by providing a theoretical basis and operational data.

3) Project design. Based on the results of the project research, discussions have repeatedly focused on the project site selection, process flow, equipment, automatic control, safety protection, environmental protection, energy saving and other perspectives.

4) Project construction. Support design and construction of civil concrete plants, phosphorus concentrate cyclone classification system (for low-quality phosphorus concentrate), raw material storage buffer mixing systems, concentrate slurry conveying systems, reaction devices, sulfuric acid conveying systems, automatic water replenishment systems, acid mixing conveying systems, automatic slurry adjusting systems, temperature control systems, acid mist treatment systems, power supply systems, intelligent control systems (intelligent control design panels), safety and protection systems, and so on.

(3) Implementation Plan

October-December 2021 to complete the work related to the project, to carry out the project startup publicity and promotion work. 2022 February-December to complete the project technology research and development, laboratory tests, the design of the project. 2023 January-December to complete the construction work of the project, and complete the debugging of the system. 2024 January-December to complete the project into the production system began to be used in the production and began to play a role. 2025 January-December to complete the project into the production system started to apply to the production, and began to play a role. January-December 2025 to re-optimize the project after it is put into production, to achieve stable operation, to make precise adjustments in the operating parameters and indicators, curing, and laying the foundation for long-term reliable operation.

Table 3-4 Project implementation schedule

Duration	Implementation plan	Main contents and arrangement	Investment budget (ten thousand RMB)
2021	Project publicity and promotion	Publicity and promotion to enhance low-carbon, energy-saving and environmental protection	21 yuan
2022	Technical preparation phase.	R&D, testing and project design	385 yuan
2023	Project construction phase	Including civil engineering, equipment and materials, automation system, environmental protection engineering, installation engineering, system commissioning	1,400 yuan
2024	Project commissioning phase (three months of commissioning planned)	0.85 million tons of sulfuric acid, 0.25 million tons of concentrate slurry, and 150,000 kWh of electricity	700 yuan
2025	Project optimization phase (project integration into production system optimization, corrective actions)	The automation control system is optimized and upgraded, the environmental protection system is optimized and upgraded, and the overall details of the project are improved and optimized	105 yuan
2026	Project Precision Optimization Phase (project integration into production system optimization, correction and further enhancement)	The automation control system is optimized and upgraded, the environmental protection system is optimized and upgraded, and the overall details of the project are improved and optimized	105 yuan
2027	Stable operation phase of the project (the project is integrated into the production system for optimization and correction,	The automation control system is optimized and upgraded, the environmental protection system is optimized and upgraded, and	105 yuan

	and then upgraded to stable operation)	the overall details of the project are improved and optimized.	

3.2.3 Application of Advanced Purification Technology to Produce High-purity Wet Purification of Phosphoric Acid

(1) Status of demonstration projects

Implementing entity: Guizhou Kailin Mining and Fertilizer Co., Ltd.

Construction location: Dashuigou Industrial Park, Jinzhong Town, Kaiyang County, Guiyang City, Guizhou Province.

Guizhou Kailin Mining and Fertilizer Co., Ltd. is a state-owned large-scale enterprise engaged in phosphorus ore mining and phosphorus coal chemical production, founded in 1958, is one of the three major phosphorus ore production bases in China and one of the backbone enterprises for the production of high-concentration phosphorus compound fertilizer. The company is a modernized large-scale enterprise group integrating phosphate ore mining, phosphorus coal chemical production, real estate, construction and building materials, trade, logistics, property and quality inspection, etc. It has the production capacity of 5 million tons of phosphate ore and 3.5 million tons of highly concentrated phosphorus compound fertilizer per year, and the total scale of enterprise assets reaches 13.6 billion RMB.

With graded utilization of phosphorus as the core, the company will develop wet purified phosphoric acid and downstream fine chemical products based on wet purified phosphoric acid on this technology. Utilizing Wengfu's mature wet purified phosphoric acid technology, we will build a 400,000-ton (85% H_3P0_4) per year PPA project. This company will fully utilize Kaiyao's high-quality phosphate resources to produce high-quality industrial-grade/food-grade phosphoric acid using wet purified phosphoric acid technology. This will lay the foundation for the further production of pyrophosphate, metaphosphate, sodium phosphate salt, potassium phosphate salt, etc., thereby realizing the centralized maximization of phosphorus resources.

(2) Implementation content

400,000 tons (85% H_3P0_4) per year PPA project, the implementation of the main body for the mining and fertilizer companies, Guizhou Phosphorus Group Kai Phosphorus plate industrial structure adjustment transformation and upgrading projects, in the existing phosphoric acid device without increasing the production capacity and production premise, will be part of the existing phosphoric acid through the 400,000

tons (85% H_3P0_4) per year PPA device, the use of filtration, extraction, purification and other technologies, the production of 246,000 tons of phosphoric acid, the production of phosphoric acid and food-grade phosphoric acid. Technology, the production of 246,000 tons of 100% P_20_5 (400,000 tons of physical acid) purification of phosphoric acid; after the implementation of the project, the output of diammonium phosphate reduced by 520,000 tons, while the production of raw phosphoric acid and phosphogypsum does not increase, in line with the current national and Guizhou Province, the relevant industrial policies and policies on comprehensive utilization of resources. The construction of the plant includes pretreatment, extraction, post-treatment, general plan, utility engineering, plant power supply and distribution, plant water supply and drainage, inner pipe and inner pipe corridor, plant communication, control room, air and nitrogen pressure station, foam fire station, tank area, and dumping ground.

(3) Implementation plan

Project construction years and schedule: April 2020-June 2026, the main unit of the project has been completed and trial production has been carried out in July 2022, and this demonstration project is expected to be fully completed in the middle of 2026. The demonstration project should be able to achieve the estimated value of phosphorus emission reduction after the completion of basic equipment installation and trial operation, and the project will be rectified and re-optimized according to the actual operating results at a later stage. In order to further improve the system, will also be combined with environmental protection requirements, plans to increase environmental protection equipment, is expected to be completed in June 2026, a comprehensive rectification, and strive to achieve the desired goals.

3.2.4 Multipurpose Large-scale Processing and Utilization of Phosphate Chemical Wastes

(1) Demonstration project situation

Implementing entity: Yunnan Phosphate Chemical Group Co., Ltd.

Yunnan Phosphate Chemical Group Co., Ltd. is a holding subsidiary of Yunnan Yuntianhua Company Limited, headquartered in Jinning District, Kunming, Yunnan Province. The company began to build mines in 1965, set up in December 2001 after restructuring, formerly known as Kunyang Phosphorus Mining Bureau and Yunnan Phosphorus Chemical Industry (Group) Company. Relying on the strong strength of phosphorus resources, the company has built four large-scale mines, namely Kunyang

Phosphorus Mine, Kunyang Phosphorus Mine No.2, Jinning Phosphorus Mine and Jianshan Phosphorus Mine, three sets of phosphorus ore scrubbing devices and two sets of phosphorus ore flotation devices. Raw ore production capacity of 11.5 million tons per year, scrubbing and processing production capacity of 6.18 million tons / year, flotation production capacity of 7.5 million tons per year; the construction of a capacity of 800,000 tons per year of sulfuric acid, 300,000 tons / year of phosphoric acid, 500,000 tons per year of feed-grade calcium phosphate salt large-scale production of phosphorus chemical production units; a capacity of 600,000 tons per year of diammonium phosphate device; a capacity of 20,000 tons per year of gum phosphorus ore flotation reagent devices The company has Class II qualification for general contracting of mining engineering, Class III qualification for blasting operation, Class III qualification for building mechanical and electrical installation engineering, Class B qualification for solid mineral exploration, Class B qualification for surveying and mapping, and excellent engineering and construction performance.

Phosphorus flotation tailing refers to the "waste" produced after the concentrates are selected by the ore-dressing enterprises using the flotation technology. It belongs to the industrial waste materials in the mining solid waste. At present, the treatment and utilization of phosphorus tailings have not found an effective method. Waste phosphorus tailings pile, not only occupy the land, the surrounding environment caused by serious pollution, but also cause the loss of a large number of useful elements in the tailings. Therefore, the discharge and stockpiling of phosphorus tailings has become a major problem restricting the sustainable dePhosphorus flotation tailings refer to the residual material left after the ore-dressing enterprises select concentrates using flotation technology. They are classified as industrial waste within mining solid waste. At present, the treatment and utilization of phosphorus tailings have not found an effective method. Waste phosphorus tailings pile, not only occupy the land, the surrounding environment caused by serious pollution, but also cause the loss of a large number of useful elements in the tailings. Therefore, the discharge and stockpiling of phosphorus tailings have become major problems restricting the sustainable development of phosphorus mine enterprises. Tailings as a potential "secondary resources", can be utilized through the develpoment of multi-channel resource utilization technologies. This includes the recovery of useful and valuable components, the development of high value-added, wide range of uses and functional diversity. Ultimately, this approach aims to render

phosphorus tailings harmless, reduce waste, and ensure the sustainable develpoment of mineral resources. Additionally, it addresses issues such as phosphorus tailings stockpiling and environmental pollution.

The project will focus on phosphorus tailings with P_2O_5 content of about 7.0%. It will conduct comprehensive research on their utilization, aiming to identify effective methods for their industrial utilization. This approach ensures the reasonable industrial utilization of phosphorus tailings, reduces the accumulation of new tailings, extends the lifespan of tailings storage, and enhances the utilization rate of phosphorus resources. Ultimately, it aims to achieve full utilization of phosphorus resources and provide an industrialized demonstration of comprehensive phosphorus tailings utilization.

(2) Implementation content

The project aims at tailings source reduction, extension of the service life of tailings storage, and resource utilization of flotation phosphorus tailings, to achieve resource utilization of 500,000 tons of flotation phosphorus tailings per year after 2023, and to form multiple industrialized application programs for use in different directions, and to provide technological support for the large-scale use of additional phosphorus tailings.

1) Flotation tailings P_2O_5 grade from 7% to 6% of the industrialization of the application of transformation

After Yunnan Phosphate Chemical Group Co., Ltd. under the phosphorus ore dressing plant for process investigation, found that due to the increased hardness and toughness of the ore, making the existing flotation system grinding capacity is insufficient, the mineral dissociation is not sufficient, resulting in high tailings grade, the phosphorus recovery rate is insufficient. Therefore, after a systematic investigation, we formulated the optimization and upgrading process route for the separation of raw ore flotation workshop and tailings re-election workshop stage grinding stage.

2) Phosphorus tailings preparation of roadbed material applications

Using the large volume of phosphorus tailings, mineral composition is relatively simple and does not contain hazardous elements. Phosphorus tailings exhibit characteristics suitable for use in building materials. These applications include: firstly, the preparation of road and drainage ditchfoundations at the grassroots or sub-base level; and secondly, the preparation of building bricks, road bricks, grass bricks, curbstones, road base materials, gravel aggregate, backfill, filler, and so on.

3) Calcium and magnesium rich soil conditioning products innovative key technologies and applications

Carry out green high-value utilization technology development and industrialization application with phosphorus tailings, and give full play to the functional characteristics of its rich Ca, Mg and P elements. Explore its utilization paths in soil conditioners, medium-volume element fertilizers, calcium and magnesium-containing composite fertilizer products and compost sharing, etc., and realize the high-value utilization of phosphorus ore associated calcium and magnesium resources, and the development of green fertilizer technology and products by innovating the production process, creating related products, and establishing the comprehensive application technology model for typical soil-crop systems. The comprehensive utilization technology development of phosphate-associated calcium and magnesium resources includes acidic soil conditioner technology and product development, medium-element fertilizers, calcium and magnesium composite fertilizer technology and product development, phosphate associated calcium and magnesium resources composting technology and high calcium and magnesium organic-inorganic compound fertilizer product development.

4) Phosphorus tailings preparation of ecological restoration matrix soil for mine land reclamation

The focus is on researching and developing a phosphorus tailings-based matrix soil formula, monitoring seepage water for ecological restoration of phosphorus tailings-based matrix soil mines, constructing an ecological restoration demonstration area for phosphorus tailings-based matrix soil mines, and building a 400,000 tons per year flotation phosphorus tailings preparation ecological restoration matrix soil demonstration device.

5) Phosphorus tailings high value utilization of key technology research and development

The research mainly focuses on investigating the chemical composition, mineral composition, particle size distribution, abrasiveness, thermal decomposition, sintering characteristics and environmental safety among other physical and chemical properties of the flotation phosphorus tailings of Yunnan Phosphate Chemical Group Co., Ltd. It aims to clarify the basic physical and chemical properties of the tailings as well as unfavorable components of the types and forms of unfavorable components. Conduct

mineralogical research and analyze the endowment and embedding characteristics of phosphorus tailings, focusing on elements such as P, Si, Al, Ca, Mg, S, among others. Emphasis is placed on researching and developing key technologies for the high-value utilization of tailings. Focus on embedded characteristics, emphasizing multi-scale characterization of key minerals within the tailings. Establish a multi-complex mineral embedding model based on the content, morphology, structure, location orientation, and distribution characteristics of mineral components. This allows for the controllable adjustment of different components of phosphorus tailings, forming a comprehensive data package.

6) Research on multi-dimensional performance evaluation method of energy-saving and carbon reduction technologies of the project

This includes researching and classifying advanced energy-saving and carbon-reducing technologies, developing multidimensional performance evaluation methods for these technologies, and studying the diffusion model mechanism of energy-saving and carbon-reducing technologies.

(3) Implementation Plan

Table 3-5 Project implementation schedule

field of research	Duration	Main contents and organization	Investment budget (ten thousand RMB)
Industrialization of flotation tailings P_2O_5 grade reduction from 7% to 6% for application modification	2023	Completion of technical research on optimization of process flow and development of process package for two sections and two closed circuits in the grinding section of raw ore and tailings re-election and grinding section, and submission of research report and process package.	1,000 yuan
	2024	Complete the project engineering design, construction and trial production, and submit the design drawings and trial production report.	
	2025	Carry out engineering commissioning and assessment work of the project, realize the reduction of P_2O_5 grade of flotation tailings to within 6%, and submit 72-hour performance assessment report.	
	2026-2027	Continuously carry out process optimization to achieve efficient and stable operation of the device, and carry out industrialization of the results to promote application.	
Application of Phosphorus Tailings in Preparation of	2023.1-2024.6	Completion of the development and research on the preparation of road and drainage ditch base materials from phosphorus tailings; completion of the development and research on the	1,900 yuan

Roadbed Materials		preparation of building bricks, road bricks, grass bricks, curbstones, road base materials, sand and gravel aggregates, backfill bodies, and filling bodies from phosphorus tailings; and completion of the optimization research on the production line's technology and equipment. Completed the paving of phosphorus tailings-based road surface and construction of drainage ditches according to the developed ratios. Submitted a report on the stage of experimental study on the preparation of low-cost grass-roots materials for roads and drainage ditches from flotation phosphorus tailings. Submitted the report on the pilot study on the stage of preparing low-cost bricks for construction, road bricks, grass bricks, curbstones, road base materials, sand and gravel aggregates, backfill bodies and filling bodies from flotation phosphorus tailings.	
	2024.7-2024.12	Complete the preparation of raw materials for flotation tailings, complete the procurement of curing agent and aggregate required for industrial test, and complete the preparatory work before industrial test. Submitted 100,000 tons per year flotation phosphorus tailings preparation of building materials project demonstration construction plan.	
	2025	Through the production line of building material products, different building material products are prepared by utilizing flotation tailings, and the performance testing of the products and the use of the products are completed. Submit an economic and technical evaluation report on the utilization of tailings to prepare building materials products. Complete the demonstration of 100,000 tons per year flotation phosphorus tailings preparation of building materials project and put it into use.	
	2026-2027	Use 100,000 tons of tailings to prepare 120,000 tons of building materials products, and the prepared building materials products meet the requirements of compressive strength $\geq$ 15.0MPa. Submit the evaluation report on the industrialization and application of the process scheme for the preparation of low-cost grass-roots materials for roads and drainage ditches from flotation phosphorus tailings. Submit the evaluation report on the industrialization and application process of flotation phosphorus tailings low-cost preparation of building bricks, road bricks, grass bricks, curbstones, road base materials, sand and gravel aggregates, backfill bodies and filling bodies.	
Innovative key technology and application of	2024	Carry out laboratory quantification of nutrient fertilizers and functional determination of phosphorus tailings, carry out experimental	2,000 yuan

calcium and magnesium rich soil conditioning products		studies on the activation of phosphorus tailings, and complete the exploration of organic and inorganic compounding and bio-composting parameters of phosphorus tailings.	
	2025	Form a preliminary process technology summary for different measures of phosphorus tailings, and carry out agronomic potting tests to verify the related processed products, screen out suitable agronomic products, and carry out field tests to verify them. Develop soil conditioner products with the functions of acid adjustment, magnesium replenishment, disease suppression, and structure improvement according to different activation technologies, and carry out the exploration of granulation technology. Design and produce green fertilizer products such as medium-quantity element fertilizers and compound fertilizers containing calcium and magnesium with full element, high efficiency and high value of phosphorus tailings resources.	
	2026	Research and development of phosphorus tailings and breeding waste mixing and composting technology, phosphorus activation and transformation technology in the composting process, and quality improvement technology of carbon and nitrogen-fixing products in the composting process, and calcium and magnesium-rich organic and inorganic composite fertilizer preparation technology, and the formation of organic composting products. Carry out agricultural effect verification and demonstration tests of different products. Completing the construction of pilot lines for conditioners, medium-volume elemental fertilizers and compound fertilizers.	
	2027	Confirmation of technical parameters of composting and finalization of related products are completed, and pilot test of organic fertilizer production is completed. For different types of soil acidification problems, design the field application program of related products, complete the field trial demonstration and observation, and promote the application.	
Preparation of ecological restoration substrate soil from phosphorus tailings for mine land reclamation	2023	Conducted research and development of substrate soil formulations for ecological rehabilitation of phosphorus tailings-based mines.	2,000 yuan
	2024	Carry out the construction of 400,000 tons per year flotation tailings matrix soil mixing device for phosphorus tailings-based mine rehabilitation and the construction of 10 acres of phosphorus tailings-based matrix soil ecological rehabilitation pilot demonstration base.	
	2025	Conduct the construction of more than 100 acres of phosphorus tailings-based ecological	

		restoration matrix soil mine ecological restoration demonstration area, and conduct follow-up testing of potential risk elements.	
	2026-2027	Conduct follow-up surveys on the growth status of various types of plants, including trees, shrubs and grasses, and continue to conduct follow-up testing for potentially risky elements.	
Research and Development of Key Technologies for High Value Utilization of Phosphorus Tailings	2023	Complete the project feasibility analysis, formulate the overall project plan, set up the project team, and form the project documentation.	1,384.8 yuan
	2024	Completed the preparation of laboratory technical research program for project implementation. Review the literature and complete the formulation design of high-calcium and magnesium-rich organic and inorganic compound fertilizers, acid-suppressing and disease-resistant soil conditioners, and composite water-retaining middle-weight element fertilizers in combination with the characteristics of phosphorus tailings materials. In the laboratory small scale, the characterization and adsorption phosphorus removal performance evaluation of natural flotation phosphorus tailings materials are carried out to explore the reaction process mechanism and parameter optimization study. Further granulation studies on flotation phosphorus tailings powder materials using various granulation methods that do not require sintering treatment, to prepare and obtain inexpensive flotation phosphorus tailings particles. Carry out the project required equipment, spare parts procurement plan submission, water and fertilizer machine control, pipeline laying and equipment debugging, while completing the soil-phosphorus tailings according to the program deployment and sapling planting.	
	2025	Formation of laboratory small trial test reports; conduct of phosphorus tailings activation and preparation of construction aggregates in the test certificate test. Conduct composition analysis and testing of basic raw materials, determine the product production process, as well as carry out the processing and production of small test products, and carry out indoor soil cultivation (potting) tests to complete the testing of soil samples and physical and chemical properties of fertilizer products. Carry out pilot application research to scale up the optimized flotation phosphorus tailings particles, apply them as phosphorus adsorbents and fillers in municipal sewage treatment plants and integrated rural sewage treatment equipment, and analyze the effect of their pilot application. Carry out unmanned management	

		of water, fertilizer and medicine for saplings, collection and monitoring of test indicators, system setup of unattended fertilizer applicator, data interchange, and completion of annual report of the project.	
	2026	Issue third-party test reports on pilot test products. Carry out the paving work of pilot test products in the demonstration road, and issue test reports on various indicators of the demonstration road. Carry out the paving work of the pilot test products in the demonstration road. Test and create products for high-calcium and magnesium-rich organic and inorganic compound fertilizers, acid-suppressing and disease-resistant soil conditioners, and composite water-preserving medium-weight element fertilizers, and carry out field trial demonstration and popularization and application for different crops in different regions.	
	2027	Issued test reports on various indicators of the demonstration road. Completion of softwritings and patent applications. Conduct practical application effect test in agricultural surface pollution water body through field test, carry out research on parameter optimization, operation and maintenance, cost and benefit, etc., and carry out stability evaluation for a period of 1 year. Conduct project report preparation and summary report of results.	
Research on Multidimensional Performance Evaluation Methods of Project Energy Saving and Carbon Reduction Technologies	2023-2025	Carry out research and classification studies on energy-saving and carbon-reducing advanced technologies. Facing the life cycle process of typical advanced technology application in the phosphate mining and processing industry, screen the resource conversion efficiency, the environmental impact of the whole life cycle, the economic costs and benefits of technology from multiple perspectives, integrate the life cycle evaluation methods, and establish a multi-dimensional performance evaluation index system.	100 yuan
	2026	Based on the entropy value method and game theory, construct an indicator weight assignment model combining subjective and objective evaluation, and establish a multidimensional performance evaluation method. Carry out the evaluation of energy saving and carbon reduction effect of this project, and carry out the calibration and optimization of the performance evaluation model.	
	2027	Sort out the typical patterns of diffusion and promotion of energy-saving and carbon-reducing advanced technologies involved in this project at home and abroad, and identify the elements, processes,	

		characteristics and functions of typical diffusion and promotion patterns.	

3.2.5 Phosphogypsum Production of Composite Fillers Project

(1) Demonstration project situation

Implementing entity: Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.

Construction location: Longfengqing village group of Willow Villagers Committee, Caopu Street Office, Anning City.

Yunnan Xiangfeng Environmental Protection Technology Co., Ltd. was established in April 2017 by Xiangfeng Group. It aims to realize the effective utilization of phosphogypsum resources and provide a solution to the impact of large quantities of phosphogypsum stockpiling on the occupation of land resources. The company specializes in research and development of comprehensive phosphogypsum utilization technology, as well as product recycling and regeneration. The company mainly relies on Yunnan Xiangfeng Jinmai Chemical Co., Ltd. and Yunnan Hongxiang Chemical Co., Ltd. for the production of phosphorus fertilizer subsidiary products derived from phosphogypsum. Additionally, it is engaged in the construction of 2 million tons per year of comprehensive utilization of phosphogypsum project.

(2) Implementation content

The project construction includes cement retarder device (phosphogypsum conveying, phosphogypsum thickening, tank area, filtration plant, cement retarder maturing storehouse), building gypsum powder device, power distribution room and turnover yard, etc. The project adopts phosphogypsum alkali washing purification process for harmless treatment prior to downstream products, such as retarder and building gypsum powder production. This breakthrough in technology overcomes the technical barrier of comprehensive phosphogypsum utilization, significantly improving the comprehensive utilization rate of phosphogypsum in Anning area. This project has been listed as one of the key projects for comprehensive utilization of industrial resources in Anning City.

(3) Implementation plan

The project is divided into three construction phases. The first phase construction time is from December 2023 to June 2024; the second phase construction time is from July 2024 to June 2025; the third phase construction time is from July 2025 to June

2026.

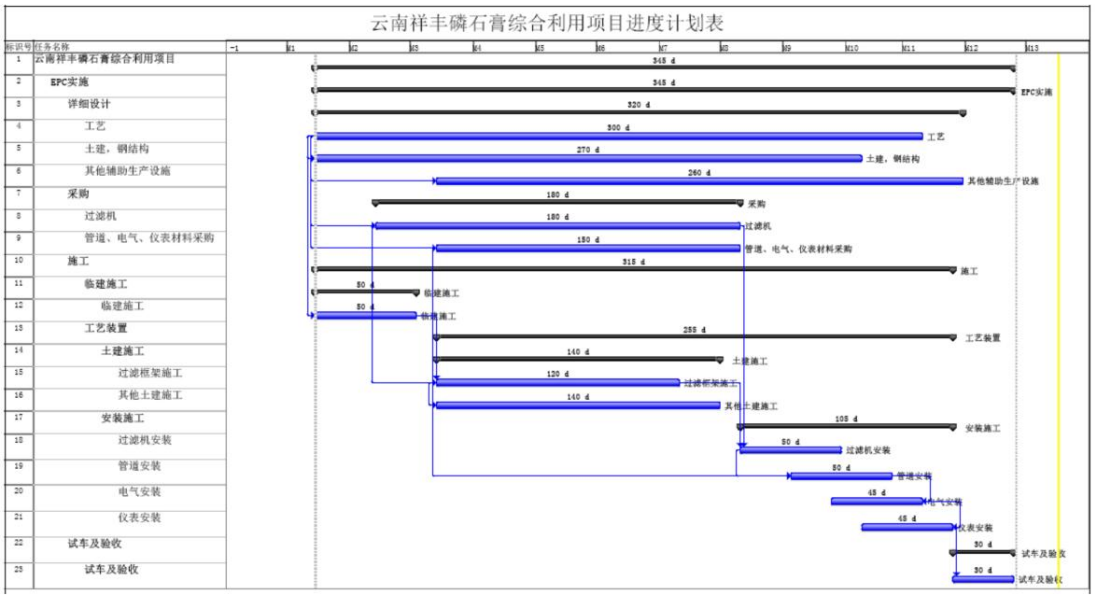


Figure 3-1 Project implementation schedule

3.2.6 Recovery and Utilization of Yellow Phosphorus Tail Gas for Power Generation Project

(1) Demonstration project situation

Implementing entity: Panzhihua Zhongli Honest Industry Co., Ltd.

Panzhihua Zhongli Honest Industry Co., Ltd. was established on May 15, 2020, and in December 2020, it acquired all the assets related to the production and operation of yellow phosphorus from Sichuan Chuantou Chemical Industry Group Co., Ltd., as well as assets related to the ongoing environmental protection, energy-saving and cleaner production technological transformation project. The company is one of the first large-scale yellow phosphorus producers to pass the national industry access announcement management. Its high-quality yellow phosphorus products are well-known both domestically and internationally, leading the industry in market share. It has been honored with the title of "Famous Brand Product of Sichuan Province".

The company normally produces 60,000 tons of industrial yellow phosphorus per year, ith a by-product of approximately 216 million Nm3 of yellow phosphorus tail gas.. However, the utilization rate of yellow phosphorus tail gas is less than 30%. The remaining 70% is burned directly and the resulting flue gas is discharged directly. Without the construction of energy-saving and environmentally friendly low-carbon upgrading demonstration projects, 70% of the tail gas produced in the production of yellow phosphorus will continue to be wasted. Without recovering heat, this will result

in inefficient operation and energy waste for the enterprise.

To fundamentally address the long-standing issue of "sky-light" emissions from yellow phosphorus furnace tail gas, the company collaborated with the Southwest Design Institute, Kunming University of Science and Technology, and Chengdu Cypress Rising Company to explore project implementation plans. Drawing on advancements in similar industries and recent technological progress, they ultimately decided in 2019 to implement a transformation program recycling yellow phosphorus tail gas for power generation. Following the program's implementation, it can fully achieve the goal of utilizing tail gas and "extinguishing the heavenly lights". The project filing was completed, and environmental impact assessments and safety pre-evaluations for relevant work began in the same year.

(2) Implementation content

Utilizing yellow phosphorus tail gas for power generation can reduce the purchase of electricity from the national grid and achieve carbon dioxide emission reduction. This energy-saving and green low-carbon enhancement project mainly aims to enhance the utilization rate of yellow phosphorus tail gas, and the equipment configuration mainly includes: two special high-temperature and high-pressure yellow phosphorus tail gas boilers, i.e., 2×75 tons per hour high-temperature and high-pressure yellow phosphorus tail gas boilers, two 20MW extractive-condensing turbines, two 20MW generators, a 4,900m^3 yellow phosphorus tail gas cabinet and DCS system, a flue-gas treatment device, and a chemical water treatment device etc.

(3) Implementation Plan

On August 11, 2022, the first set of yellow phosphorus tail gas generator set was put into operation; from January 2023 to December 2023, the second set of yellow phosphorus tail gas generator set was constructed with steam turbine, generator debugging, boiler, pollution treatment facilities and equipment, and 4,900m^3 gas cabinet; from January 2024 to May 2024, the stand-alone machine debugging and linkage test work; it is planned that in June 2024, the second set of The second yellow phosphorus tail gas generator set is scheduled to be formally connected to the grid and put into operation in June 2024 after completing the linkage test.

4. Baseline Data

4.1 Application of Full Tailings Filling Technology in Underground Phosphate Mines

4.1.1 Socio-economic

The construction site of the project is centered in Fuquan City, Guizhou Province, and consists of five parts: (1) expanding the concentrator and ancillary facilities within the Xinlongba concentrator; (2) renovating and heightening and expanding the capacity of the tailings storage at Baiyan Tailings Storage Facility; (3) constructing a new phosphorus concentrate conveying pipeline and utilizing the original concentrate conveying pipeline technology to realize the concentrate filtration and return of water between Xinlongba Concentrator and Machangping Wengfu Phosphate Fertilizer Factory; (4) constructing a tailings filling system in Machangping Wengfu Phosphate Fertilizer Factory on the site of the original filtration plant. (4) Expansion of phosphate concentrate dewatering facilities and loading system on the site of the original filter press workshop in Machangping Wengfu Phosphate Fertilizer Plant; (5) Construction of tailing filling system in Datang mine section.

The project ore dressing plant and tailings storage are located in Niuchang Town, and the phosphate fertilizer plant is located in Machangping. Fuquan City is connected with Wengan county in the north, neighboring Kaili city and Huangping county in the east, bordering Majiang county in the south, and Guiding, Longli and Kaiyang counties in the west. The city has a total area of 1,688km^2, with a maximum length of 55.2km from north to south and a maximum width of 52.1km from east to west. 9 towns, 6 townships, 2 offices, 16 neighborhood committees and 60 village committees are under the jurisdiction of the city. The city has a total population of 316,700, of which 62,000 are non-agricultural and 85,400 are ethnic minorities. There are 25 ethnic groups, including Han, Miao, Buyi, Dong, Yi and Shui.

Niuchang Town is one of the 100 key towns in the province and one of the 1887 key towns in the country, located in the north of Fuquan City, Qiannan Prefecture, with a land area of 103km^2, seven administrative villages under the jurisdiction of three neighborhood committees, and a total population of 34,000 people, with a population of 14,000 people in the town area. The planning area of the town is 4.17km^2, the built-up area is 3.24km^2, and the urbanization development level is 34.7%.

Machangping Office covers an area of about 46km^2, with a population of 30,216 at the end of 2011. Jurisdiction over three villages (Machangping Village, Sanbao Village, Pingbao Village) and three neighborhood committees (Bishan Community Neighborhood Committee, Jinshan South Road Neighborhood Committee, Hongfu

Community Neighborhood Committee (no jurisdiction)); paddy field area of 5,553 acres, dryland area of 1,865 acres.

There are no scenic spots, nature reserves, cultural relics protection zones and water source protection zones within 2500m around the ore dressing plant, 500m around the tailing pond construction area and its surroundings, 2000m downstream and 200m on both sides of the concentrate conveying pipeline of this project. **The project's phosphate concentrate transport and water return pipeline passes through the Shajin Valley Scenic Spot in Fuquan City.**

4.1.2 Environmental

Geology and geomorphology. The topography of Fuquan City is higher in the west and north, followed by the east, and lower in the center and south, with the highest elevation of 1715.8m, the lowest elevation of 614m, and the average elevation of 1020m. The geomorphology type is dominated by mountains. Xinlongba Ore Dressing Plant is located in the Sichuan Road about 10km northwest of Niuchang Town, Fuquan City, with north-south trending mountain beams clamping the east and west sides, and the plant is situated on a nearly elliptical hillock, with the center of the plant at the geographic coordinates of longitude 107°22 ′ 55.86 "E and latitude 26°57 ′ 48.79 "N. The highest elevation of the plant is 1290m above sea level, and the lowest elevation is 614m, with an average elevation of 1020m. The highest elevation is 1290m above sea level and the lowest elevation is 1237m above sea level (accident pool), with a height difference of 53m. Baiyan tailing pond is located in the south of Xinlongba processing plant, with a straight line distance of about 6.0km. the geomorphology of the mining area belongs to the tectonically denuded middle and low mountains, with the highest point of the Beidou Mountain, with the elevation of 1545m above sea level, and the lowest point of the Rock Hang River mouth, with the elevation of 998m above sea level. This area is a sedimentary rock area, the basement strata are Shilengshui Formation of middle Cambrian system and Loushanguan Group of Middle Upper Cambrian system, mainly by the thin or thick layer of dolomite composition. The project site has good stability of regional geology and tectonics.

Hydrogeology. The hydrogeological conditions in the project area are relatively simple. The groundwater type is dominated by carbonate karst water (mainly karst fissure water), in addition to the weathering fissure water of bedrock and pore water of the fourth system, which are very weak in water-rich nature. In terms of hydrodynamic

conditions, diving is the main type of water, and pressurized water can be formed when there is a local relative water barrier. Groundwater is mainly stored in the rock crevices and is transported and discharged along the dissolution fissures.

Soil and vegetation. Soils in the project area are mainly loam and limestone. Loam is generally thick, with obvious development levels, sticky or sandy texture, pH 4~6.5, low salt saturation, low nutrient content, and lack of phosphorus and potassium. Lime soil is generally shallow, sticky and heavy, with high salt saturation, alKailine or neutral pH, high organic matter content compared with zonal soils in the same area, loose surface layer, good structure, but shallow and thin, poor water retention, and not drought-resistant. The project area belongs to subtropical evergreen broad-leaved forest belt, due to the impact of man-made activities, in addition to some sections still preserved a small area of native evergreen broad-leaved forest, the vast majority of the area has ceased to exist. Typical forest vegetation types include evergreen broad-leaved forests with the dominance of Dolichospermum and Chuangui, mixed coniferous broad-leaved forests with the dominance of Horsetail Pine and Birch, and coniferous forests with the dominance of Horsetail Pine; typical scrub vegetation is the thickets with the dominance of Masan, White Oak; typical mountain grass slope vegetation is the grass slope of Hairy Axis Fern and the mountain grass slope with the dominance of White Trifoliate Grass, Tianhu Shrubs and Early Gramineous. There are also village scenic forests, localized light bamboo forests, chemical incense forests and other vegetation types in the area.

Atmospheric Environment. The project is located in Niuchang Town, Fuquan City, Qiannan Buyi and Miao Autonomous Prefecture, Guizhou Province, which belongs to the rural area, and according to the principle of ambient air functional zoning, the regional ambient air quality is classified as Class II area.

Water Environment. The surface water body in the area where the project ore dressing plant is located belongs to the water system of Wujiang River, and the surface water body along the concentrate and catchment transportation pipeline from Xinlongba ore dressing plant to Machangping dewatering project belongs to the water system of Qingshuijiang River. According to the "Provisions on Functional Classification of Surface Water Environment in Guizhou Province", the surface water body of Matian River in the evaluation section of the area where the project concentrator is located belongs to Class III water body. According to "Groundwater Quality Standard"

(GB/T14843-93), groundwater quality classification "based on human health benchmarks", the groundwater mainly applicable to centralized domestic drinking water sources and industrial and agricultural water for Class III water quality, therefore, the groundwater in the project area belongs to Class III water bodies.

Acoustic environment. The mining area of this project belongs to the rural area with more industrial activities, and is classified as Class 2 Acoustic Environment Functional Area according to the "Acoustic Environment Quality Standard" (GB3096 -2008).

Soil environment. The average soil erosion modulus of the project area is about 1963 tons per square kilometer per year, which is moderate erosion. The project area does not belong to the key soil erosion prevention and control area announced by the state, but belongs to the key treatment area and key supervision area in the Announcement of the People's Government of Guizhou Province on the Division of Key Soil and Water Erosion Prevention and Control Areas, and belongs to the southwestern soil and rocky mountainous area in the National Soil Erosion Type Classification which is dominated by hydraulic erosion, with a permissible loss of soil of 500 tons per square kilometer per year. There are no special facilities for water conservancy and water conservation projects in the project area. Soil and water conservation facilities are mainly for cultivated land, forest land and barren grassland.

Existing project environmental protection measures and implementation. The approval documents of the environmental assessment of the existing project are complete, and the environmental protection measures meet the relevant requirements.

Table4-1 Engineering environmental protection measures and implementation

Form		Environmental measure	Implementation of environmental protection measures
Xinlongba Concentrator	Drain water	Beneficiation plant production wastewater recycling, domestic sewage biochemical treatment	Recycling tailing water, dense water and acidic water as water for ore dressing production, a set of 5m^3 per hour integrated wastewater treatment facility has been constructed.
	Off-gas	Treatment of dust in mineral processing plant, treatment of waste gas containing fluoride and sulfuric acid mist without organization	Ore transportation is set up with belt gallery, crushing and screening dust is set up with bag filter to remove dust and then discharged from the exhaust pipe; powdered ore is set up with silo storage, silo roof is set up with dust collector and exhaust pipe, and a small amount of fugitive fluoride exhaust from flotation workshop is discharged through the

			workshop air exchange system, and sulfuric acid storage tanks have been canceled.
	Noises	Noise management for crushing and ball milling in mineral processing plant	Separate specialized workshops for crushing and ball milling
White Rock Tailings Storage Facility	Drain water	Collection pond and pump house below the dam	There are collection ponds and pump houses below the dam, and the tailings water is basically reused in its entirety
	Dust	Initial and late dam block berms	Initial and late dam block berms
	Noises	Tailings water transfer pump with pump house	Dedicated pump room
	Tailings slurry transportation pipeline	Tailings slurry transportation pipeline	Construction of 2 tailings slurry transportation pipelines
	Tailings Water Transportation Pipeline	Tailings Water Transportation Pipeline	Construction of a tailings water transportation pipeline
	Soil and water conservation and ecological restoration measures	Tailings pond drains, landscaping	The tailing pond is equipped with intercepting ditches on both sides, guide drains in front of the dam, and block stone piles on the dam surface to effectively prevent dust and soil erosion
Concentrate slurry transfer lines	Slurry Transportation Pipeline	The entire pipeline is closed, casing is installed when passing through bridges and highways, and the pressure control system is checked and controlled.	Implemented in accordance with engineering requirements
Acid wastewater transfer lines	Acid water transfer lines	The entire pipeline is closed, the pipeline is made of corrosion-resistant special materials, casing is installed when passing through bridges and highways, and the pressure control system is checked and controlled	Implemented in accordance with engineering requirements
Risk prevention Measures	Xinlongba Concentrator Accident Pool	Construction of an accident pool to prevent the leakage of mineral processing slurry and mineral processing water due to the shutdown of production accidents.	One accident pool with a volume of 2,000m^3 and one accident pool with a volume of 6,000m^3 are built in the south of the processing plant, which can effectively prevent the wastewater from being discharged out of the processing plant.
	Dump of mining waste	Interceptor drains on both sides of the tailings pond, stone stacking on the dam surface, observation wells, and seepage facilities	Build O&M as required

		inside the pond	

4.2 Intelligent Device and Application of Mixed Acid Preparation for Phosphorus Float Selection

4.2.1 Socio-economic

Mabian Laoheba Phosphorus Mining Area Copper Factory Ridge (No.8 ore block) phosphate mine is located in Mabian Yi Autonomous County, Leshan City, Sichuan Province (referred to as Mabian County) south of the city of 226 ° straight distance 19km, originally belonged to the jurisdiction of Baijiawan Township, because Baijiawan Township has now been merged with the Yanfeng Township unified renamed as Yanfeng Township, so it belongs to the jurisdiction of the Yanfeng Township. The scope of mining right of the mine is No.8 block of Copper Factory Ridge section of Laoheba Mining Area of Mabian Phosphorus Mine, covering an area of 2.9885km^2.This project relies on the original ore dressing plant, and utilizes as much as possible the existing equipments, workshops and open space of the ore dressing plant as much as possible. Newly added mixed acid preparation and intelligent control system, concentrate classification system, concentrate slurry conveying system, sulfuric acid conveying system, mixed acid conveying and blending system, water and electricity conveying system, environmental protection and fire-fighting facilities, so as to achieve the design supporting capacity.

Mabian County is located in the southwest edge of the Sichuan Basin, small Liangshan District, is located in Leshan, Yibin, Liangshan three cities and states combined, with jurisdiction over 2 towns, 18 townships, the county has a total area of 2383km^2, with a total population of 180,000 people, mainly Han Chinese, Yi accounted for 37% or so, with a small number of Miao, Hui and Zhuang.

Mabian County is rich in mineral resources, there are phosphorus, gypsum, lead and zinc, copper, gold, silver, iron, tin, crystal, coal and other mineral resources, of which phosphorus reserves of 2.48 billion t, listed in the country's eight major phosphorus mines in the fourth place, the old Heba mine has been proved reserves of 609 million t. Theoretical reserves of hydraulic resources of 656,400,000 kW, is the city of Leshan City two river basin development of the focus of the region, the city of Leshan, Mabian County has been drawn up to develop the Mabian River resources

planning, a number of water resources, water resources, water resources, and the development of the Mabian County. Mabian River resource planning, a number of hydropower stations are under construction. In recent years, Mabian County, relying on phosphorus ore, water energy and rich agricultural products resource advantages, accelerate the construction of hydropower, PCI, agricultural and sideline products deep processing of the three major industrial pillar industries pace, to promote the rapid development of the industrial economy, 2020 regional gross domestic product (GDP) of 539,695,000 yuan, the annual investment in fixed assets of 649,385,000 yuan, the annual county-level financial income of 393,480,000 yuan of the general budget. The annual per capita disposable income of urban and rural residents is 18,953 yuan, and the per capita disposable income of rural residents is 13,921 yuan.

4.2.2 Environmental

Topography and geomorphology. The mine is located in Mabian Yi Autonomous County in Sichuan (Mabian County for short), Leshan City, Sichuan Province, 33km west of the south of the city, the mine is located in the high mountains and deep valleys, rolling hills, steep slopes and deep valleys, steep hills, deep valleys, deep river valleys and rapid water flow. The overall geomorphology is a tectonic erosion landform, the terrain is high in the west and low in the east. The highest Dabao top is 2090m, the lowest Haroro River is 740m, the relative height difference of 1300m, generally 500-700m, belongs to the middle mountainous area.

Hydrological status. Zhangjialat (ditch) is located in the eastern part of the proposed mining right No.8 mining block, flowing from south to north through the east side of the proposed ore dressing plant, and merging into the Harrow Royda (river), which is a cut-off branch ditch. The catchment area is about 2.0km^2, the ditch valley is steep and slow, the upper slope drops 26%, the lower part of the slope drops 5 ~ 10%, the measured flow rate is about 0.05m^3 per second, the estimated maximum flow rate is about 0.9m^3 per second. The Harrow Royda (River) flows through the northern part of the concentrator plant from the west to the east, and the slope drop of the ditch bed in the north side of the site is 6.12 ‰, and the valley is mostly in a "V" shape, with a flow rate of 4.0m^2, and the flow rate of 4.0m^2. " shape, with a flow rate of 4.34-58.98m^3 per second.

Climate and meteorology. The climate of this area is the middle subtropical monsoon wet climate, due to the role of the barrier of the western mountains, from the

basin of warm moist air is blocked, in the area of the formation of foggy rainy climate; characterized by abundant precipitation, the four seasons, due to the terrain difference in height, three-dimensional climate is obvious. According to the local meteorological observation data, the average annual temperature in the area is 19℃, the hottest month of the year is July, with an average of 25.3℃ and an extreme maximum temperature of 37.5℃; the coldest month is January, with an average of 7.4℃ and an extreme minimum temperature of -4.0℃; the average annual rainfall is 1,044.3mm; the average annual wind speed is 1.5m per second, and the wind direction is dominated by the north wind throughout the year.

Status of soil erosion. According to the relevant data, Mabian County has an erosion area of 100,587 hectares, accounting for 42.21% of the total area, with an average erosion modulus of 3641.72 tons per annum per square meter, a total average annual erosion volume of 3,663,100 ton, and an average annual thickness of soil erosion of 2.8mm, of which the area of mild erosion is 28,331 hectares, accounting for 28.2%; the area of moderate erosion is 37,914 hectares, accounting for 37.7%; and the area of intense erosion is 28,331 hectares, accounting for 28.2%; the area of medium erosion is 37,914 hectares, accounting for 37.7%; intensity loss area of 22,148 hectares, accounting for 22%; extreme intensity loss area of 8,540 hectares, accounting for 8.5%; intense loss area of 3,654 hectares, accounting for 3.6%, no obvious loss area of 137,706 hectares, accounting for 57.8% of the area. The county has the highest ratio of loss area in Shuinianba Township, accounting for 86.9% of the area of the township. The loss of Suiba Township is the most serious, with its drastic loss area accounting for 54.7% of the county's drastic loss area and 33.2% of the township's loss area.

Special environmental protection target situation. The new beneficiation sections are all within the red line of the industrial site of the existing processing plant project. There are no famous and ancient trees and rare wild animals and plants within the occupied area of the project's industrial site that require special protection under state regulations. There are no ancient tombs, ancient temples and other cultural relics and monuments within the scope of the project.

Environmental quality status quo. According to the original Environmental Impact Report of the project, the petroleum class detection value at 10m upstream of the confluence of Zhangjiala Ditch and Haroro Yida River slightly exceeds the standard, and since the petroleum class of the downstream section does not exceed the standard, it

is estimated that the section of the river has been locally subjected to the exceeding of the standard caused by the discharge of domestic sewage, and due to self-purification of the water, the water quality of the downstream section of the river is gradually restored. In addition, the Pb monitoring values 20m upstream of the confluence of Zhangjiala Ditch and Haroro Yida River and 50m upstream of the Haroro Yida River confluence exceeded the standard. Since the area is rich in mineral resources, it is possible that the Pb concentration in the evaluated river section exceeds the standard due to the influence of the high background value of Pb concentration in the soil. In addition to the above items, all other monitoring items meet the standard limit of Class III waters in the Environmental Quality Standard for Surface Water (GB3838-2002), and in general, it seems that the environmental quality of surface water in the project area is average. The status quo of regional ambient air quality is good and meets the requirements of Class II standard in Ambient Air Quality Standard (GB3095-2012). The noise monitoring value of the plant boundary of this project is within the standard limit, and the status quo of environmental noise is good.

4.3 Application of Advanced Purification Technology to Produce High-Purity Wet Purification of Phosphoric Acid

4.3.1 Socio-economic

The proposed site of this project is located in the open space reserved for fine phosphorus chemical planning in Dashuigou Industrial Park, Kaiyang County. Under the premise of not increasing the capacity and output of the existing phosphoric acid plant, the existing part of the phosphoric acid through 400,000 tons (85% H_3P0_4) per year PPA device, using filtration, extraction, purification and other technologies, to produce 246,000 tons of 100% P_20_5 (400,000 tons of physical acid) purification of phosphoric acid; after the implementation of the project, the output of diammonium phosphate is reduced by 520,000 tons, and the production of raw material phosphoric acid and the amount of phosphogypsum does not increase. After the implementation of the project, the output of diammonium phosphate will be reduced by 520,000 tons, while the output of raw phosphoric acid and the amount of phosphogypsum will not be increased, which is in line with the national and Guizhou Province's current industrial policy and comprehensive utilization of resources. The construction of the plant includes pretreatment, extraction, post-treatment, general plan, utility engineering, plant power supply and distribution, plant water supply and drainage, inner pipe and inner

pipe corridor, plant communication, control room, air and nitrogen pressure station, foam fire station, tank area, and dumping ground.

Kaiyang County is subordinate to Guiyang City, Guizhou Province, located in the hinterland of Qianzhong, with a total area of 2,026 square kilometers, 3 streets, 7 towns and 8 townships. It is 66 kilometers away from Guiyang, the capital city of the province, and 110 kilometers away from Zunyi, the historical city, and is located in the sub-center area connecting Guiyang and Zunyi. 2020 Kaiyang County has a permanent population of 343,871, a gross regional product of 28.920 billion yuan, and it is the fifth batch of the national ethnic unity and progress demonstration area. Kaiyang County has the reputation of "the hometown of Chinese prose poetry", "the hometown of selenium-rich agricultural products in China", "China's green phosphorus capital" and "karst ecological world park". "It is the first national recycling economy phosphorus coal chemical ecological industrial demonstration base county and Guizhou Province's economic power county. Kaiyang County's high-quality rich ore reserves of 392 million tons, is one of China's famous three major phosphorus producing areas, with Xiangyang, Hubei, Yunnan Kunyang and known as the "three suns".

The area where the plant is located is surrounded by a large number of phosphorus resources, no nature reserves, landscapes and important political and cultural areas.

4.3.2 Environmental

Air Quality. The source of raw data for this report is the day-by-day air quality monitoring data of Kaifeng County Ambient Air Quality Monitoring Station in 2019.SO_2, $NO_2$24h average and 98th percentile concentration and annual average concentration satisfy the requirements of the secondary standard of Ambient Air Quality Standard (GB3095-2012); PM, PMs24h average and 95th percentile concentration and annual average concentration satisfy the requirements of the secondary standard of Ambient The 24h average and 95th percentile of PM, PMs and the annual average concentration of PM meet the requirements of the secondary standards of Ambient Air Quality Standards (GB3095-2012); the 24h average and 95th percentile of CO meet the requirements of the secondary standards of Ambient Air Quality Standards (GB3095-2012); and the 90th percentile of the maximum 8h sliding 8h average of daily average of O_3 meet the requirements of the secondary standards of Ambient Air Quality Standards (GB3095-2012). According to the supplementary test report, it is known that the characteristic pollutant hydrogen fluoride meets the requirements of the secondary

standard of Ambient Air Quality Standard (GB3095-2012); P0s, hydrogen sulfide and TVOC meet the requirements of Appendix D of the Technical Guidelines for Environmental Impact Assessment of the Atmospheric Environment.

Surface water environmental quality. The project's wastewater accidental discharge receiving water body is Yangshui River, the evaluation uses Guizhou Yueqing Harmonious Environmental Monitoring Service Co. Ltd.'s monitoring data on the status quo of the water environment quality of the Yangshui River on January 4~6, 2019 to evaluate the environmental quality of the surface water in the region. In the three surface water monitoring sections, the monitoring indicators all meet the Class I standard and reference standard of GB3838-2002 "Surface water Environmental Quality Standard", and the evaluation of regional surface water environmental quality is good.

Groundwater environmental quality. The evaluation cites the Environmental Status Monitoring Report on the Recycling Economy Utilization-Annual Output of 30,000 Tons of Anhydrous Hydrogen Fluoride Project of Guizhou Wengfu Kailin Fluorosilicon New Material Co. [GZHHHJ026(2019)], which was reported from April 13, 2019 to April 15, 2019 for monitoring. All water quality monitoring items include pH, total hardness, total dissolved solids, fluoride, sulfate, oxygen consumption, ammonia nitrogen, mercury (Hg), arsenic (As), chromium (Cr6+) total coliforms, total phosphorus, etc.; all the water quality monitoring items of the Heba spring point, the Six Buckets spring point, the Trough Soil spring point, the Chayuanpo spring point, the Hot Water Gully spring point, and the Dashui spring point are able to reach the "Groundwater Quality Standard" (GB/T14848 All water quality monitoring items can reach the IV standard of Groundwater Quality Standard (GB/T14848-93).

Acoustic environment quality. Guizhou Haohua Engineering Technology Co., Ltd. conducted current status monitoring of acoustic environment quality around the plant boundary of the Project on February 19, 2020 and issued the Environmental Status Monitoring Report of 400,000 Tons (85% H_3PO_4 Yearly PPA Project of Guizhou Kailin Mining and Fertilizer Co., Ltd.[GZHHHHJ010(2020)]. The daytime and nighttime noise monitoring results of the four plants boundary environmental noise monitoring points on the east, south, west and north sides of the plant boundary where the project is located satisfy the Class 3 standard of the Acoustic Environment Quality Standard (3096-2008).

Soil boundary quality status. The monitoring results of characteristic factors within the plant boundary are detailed in the Environmental Status Monitoring Report of

400,000 tons (85% H_3PO_4) per year PPA Project of Guizhou Kailin Group Co.[GZHHHJ006(2018)], and the test results of background points outside the plant boundary are quoted from the Monitoring Report of Soil Environmental Status of Recycling Economy Utilization-Annual Production of 30,000 Tons of Anhydrous Hydrogen Fluoride Project of Guizhou Wengfu Kailin Fluorine and Silicon New Material Co. Report". According to the test results, it can be seen that all the detection factors in the soil environment within the evaluation range of the project site and the site location meet the requirements of the second category of selected values in Table 1 of the "Soil pollution risk control standards for soil environmental quality construction land" (GB36600-2018).

4.4 Multi-Purpose Large-Scale Processing and Utilization of Phosphate Chemical Wastes

4.4.1 Socio-economic

Ltd. is a holding subsidiary of Yunnan Yuntianhua Company Limited, headquartered in Jinning District, Kunming City, Yunnan Province. Relying on phosphorus resources, the company has constructed three large-scale open-pit mines, namely Kunyang Phosphorus Mine, Jinning Phosphorus Mine and Jianshan Phosphorus Mine, and one underground mine under construction of Kunyang Phosphorus Mine No.2, three sets of phosphorus ore scrubbing devices and two sets of phosphorus ore flotation devices; the production capacity of the raw ores is 11.5 million tons per year, and the production capacity of scrubbing and beneficiation is 6.18 million tons per year, and the production capacity of flotation is 7.5 million tons per year; the company has constructed two sets of gum There are 2 sets of flotation reagent devices with a total capacity of 31,000 tons per year; 1 set of large-scale phosphorus chemical production device with a capacity of 800,000 tons per year of sulfuric acid, 300,000 tons per year of phosphoric acid, and 500,000 tons per year of feed-grade calcium phosphate salts; 1 set of diammonium phosphate device with a capacity of 600,000 tons per year; 1 yellow phosphorus device with a capacity of 40,000 tons per year; 1 high-purity phosphorus pentoxide device with a capacity of 4,000 tons per year; and 1 set of electronic-grade phosphoric acid device with a capacity of 30,000 tons per year; It possesses the Grade II qualification for general contracting of mining engineering construction, the Grade III qualification for blasting operation, the Grade B qualification for solid mineral exploration, the Grade B qualification for surveying and mapping, as well as excellent

engineering and construction performance. The comprehensive performance and mining technology and economic indexes are at an excellent level in the national chemical mining industry.

The company's existing 10 mining rights, due to the protection of Dianchi, water source protection policy impact and the impact of the construction period, only Tangjiashan mine section, Songshan mine section, Kunyang phosphorus mine two normal mining, Jinning phosphorus mining scale of 1.3 million tons per year, Xiaojiaying phosphorus mine is undergoing infrastructure is not normal mining, Ganhaizi phosphorus mine has been overdue for the continuation of the Kunyang phosphorus mine is in the protection of the Dianchi pond, the mining has been halted. Calculated and verified, has been handled within the scope of the soil and forest land for open-pit mining resources of about 32.26 million tons, outside the protected area has been handled in the soil and forest land can be mined about 27.56 million tons, the average grade of 25.24%.

4.4.2 Environmental

Yunnan Phosphate Chemical Group Co., Ltd., Ltd. mines are in the Dianchi surrounding the region's climate is a plateau warm belt monsoon climate, according to the Kunming Meteorological Bureau in January 1985 ~ December 2004 a total of 20 years of observation data statistics, the average temperature in the region for many years 15.4 ℃, the hottest month average temperature of 19.3 ℃, the extreme maximum temperature of 31.6 ℃; the coldest month average temperature of 8.5 ℃, the extreme minimum temperature -4.6 ℃, the coldest month average temperature of 8.5 ℃, the extreme minimum temperature of -4.6 ℃. 4.6℃. The average rainfall over the years is 907.7mm, with the maximum rainfall of 1140.1mm (1994) and the minimum rainfall of 544.8mm (1988), the maximum rainfall of 125mm in a day, and the maximum cumulative rainfall of 203.8mm (the cumulative amount of rainfall for 18 consecutive days). The rainy season is from May to October each year, accounting for about 86.2% of the annual rainfall. The average evaporation over the years is 1863.3mm, the maximum evaporation is 2126.0mm; the minimum evaporation is 1557.9mm. the average wind speed over the years is 2.5m per second, the most wind direction is south, south-south westerly. The maximum wind speed is 3.4m per second, and the maximum wind direction is southwest westerly. Multi-year average relative humidity 72.3%, maximum relative humidity 76%, minimum relative humidity 68%; multi-year average

absolute humidity 12.7%, maximum absolute humidity 13.2%, minimum absolute humidity 12%. Multi-year average air pressure 811.2 mbar, maximum air pressure 812.4 mbar, minimum air pressure 809.3 mbar.

Yunnan Phosphate Chemical Group Co., Ltd. land reclamation, environmental protection work started in the 1980s, always follow the "protection in the development, development in the protection" principle, especially since 2004, increase efforts, increase investment, innovative management, reclamation of vegetation to form a long-term mechanism, has won the "National Advanced Unit of Land Reclamation", "National Advanced Unit of Land Reclamation", "National Advanced Unit of Land Reclamation". National Advanced Unit of Land Reclamation", "National Advanced Unit of Environmental Protection" and the title of "Advanced Unit of Environmental Protection, Greening and Afforestation, Environmentally Friendly Mines in Yunnan Province". The four main mines of Kunyang Phosphorus Mine, Haikou Phosphorus Industry (joint venture), Jinning Phosphorus Mine and Jianshan Phosphorus Mine were rated by the Ministry of Land and Resources as "national green mines" and passed the official acceptance, realizing the full coverage of green mines. As of 2017, Phosphate Group has invested nearly 900 million R in reclaiming vegetation, planted nearly 45,000 acres of trees and forests, and the land reclamation rate of reclaimable vegetation area has reached 94.7%. At present, the geological environment of the mine mining waste land has been effectively restored and managed, land reclamation vegetation area formed a certain scale of ecological forests and economic forests, recreating a beautiful new environment of the mine. At the same time, combined with its own advantages, actively explore new ways of economic growth outside the main business of phosphate mining, around the "revitalization of stock, the development of incremental, good demonstration, drive the surrounding" principle, to strengthen the secondary development of land resources in the reclaimed area, and actively build a national mine park, urban farms, through seedling breeding and forest economy planting demonstration research and implementation, so as to form a new environment for phosphate mining. Through the research and implementation of seedling breeding and forest economic planting demonstration, we can form an industrial undertaking after the decline of the scale of phosphorus mining and realize the sustainable development of Phosphorus Chemical Group.

4.5 Phosphogypsum Production of Composite Fillers Project

4.5.1 Socio-economic

The project is located in Longfengqing village, Caopu Town, Anning City, with geographic coordinates: 102°21′~102°23′E, 24°58′~24°59′N. The project is located in Longfengqing village, Caopu Town, Anning City. There are highways connecting to Kunming 30km in the north east, Anning 13km in the south east, and Caopu Town 5km in the south. There are mine roads and inter-village highways in the area connected with the provincial highway. Caopu Town is a town under the jurisdiction of Anning City, Yunnan Province, is located in the city of Anning City, west of the Kunwan Highway 45 kilometers from the city of Anning 12 kilometers from the 320 National Highway and Anchu high-grade highway through the territory, east of Lianran Town, west of Lubiao and Yimen County, south of Xianjie Township, the north of the town of Qinglong and Wenquan, the main channel the main channel and important station entrance to western Yunnan. The town has 8 villagers' committees and 1 community residents' committee, 41 villagers' groups and 2 residents' groups, with a total area of 171 square kilometers.

The main works of this project include new pipeline project, production line and phosphogypsum temporary storage yard. The pipeline project includes: an 8km-long phosphogypsum slurry pipeline and a 6km-long return water pipeline. The production line includes one 2 million tons per year phosphogypsum pretreatment production line, three 500,000 tons per year cement retarder production lines and one 500,000 tons per year construction gypsum powder production line. The phosphogypsum temporary storage site covers an area of 288,221.4411m^2 (432.33mu) with a total volume of 1.6 million m^3.

4.5.2 Environmental

Topography and geomorphology. The phosphogypsum comprehensive utilization project is located in the central part of the Yunnan-Guizhou Plateau, which is a tectonically eroded low to medium mountainous area, and is located within the Mantis River basin. The comprehensive utilization of phosphogypsum site is located in the south side of Longfengqing phosphogypsum turnover site, belonging to the mountainous area, the general geomorphological pattern is high in the east side and low in the west side, the elevation of the mountains is 1858~1956 m. The Mantis River is located in the north side of the phosphogypsum turnover site of Longfengqing, and the river valleys and basins are developed, with the elevation of the river generally ranging

from 1450~2000 m. The nearest distance from the dam site to the Mantis River is about 1,000 meters. The nearest distance of the Longfengqing Phosphogypsum Turnaround Site dam site from the Mantis River is about 1000m.

Climate and meteorology. Phosphogypsum comprehensive utilization project is located in the central low-latitude zone of the central Yunnan plateau, belonging to the subtropical plateau monsoon temperature and cool climate, the climate is mainly affected by the southwest monsoon, forming a "winter and spring drought, summer rainy, four seasons, no cold and heat, when the rain turns into a winter" climate characteristics, the average temperature for many years is 14.7 ℃, the average temperature of the ground for many years is 18 ℃, and in recent years, the ground temperature has been slightly rising for more than two decades. For more than two decades, the ground temperature has a slightly rising trend. The average precipitation for many years is 886.5mm, and the precipitation in the year of abundance and dryness is between 1161.8 and 553.9mm, with the maximum daily rainfall of 153.33m and the maximum annual rainfall of 1161.8mm; it is a water-poor area. The annual average sunshine is 2054.5h, the annual evaporation is 2000mm, the frost-free period is 229 days, there are 54 days of fog days in a year, and the most years of fog days amount to more than 100 days. May to October for the rainy season, November to April for the dry season, the rainy season is concentrated in June to September.

Hydrogeology. The area where the phosphogypsum comprehensive utilization project is located belongs to the Jinsha River water system, and the main rivers are Mantis River. Mantis River is the right side of the Jinsha River system, Class I DC, the source is located in the Dianchi drainage outlet, the river from south to north runoff, the size of the tributaries, from the east and west sides to the Mantis River convergence. The main tributaries are the big river, lu laminating river, big ying river, etc., the water system is a dendritic spread. The whole basin is 148.65km2, with a slope drop of 0.29%. Mantis River flows out of the Dianchi drainage outlet, to the north-west direction through Anning and other places, turning to the north-northeast direction, through the Fumin small estuary. The maximum peak flow is 350m^3 per second, some of the branch ditches are broken in the dry season, and the peak flow is 2.95m^3 per second in the driest season, with great dynamic changes. Longfengqing turnover site of phosphogypsum is located in Longfengqing turnover tributary ditch on the right side of Nianmuzhuang in Mantis River Basin, which is a seasonal ditch, with surface runoff

gathering and flowing out in rainfall, injecting into Mantis River, dry or with a small amount of water flow in dry season, and the flow is generally less than 2L per second. The area where the phosphogypsum utilization project is located is in the west of the Yangtze quasi-terraneous plateau, the south of Chuan-Yunnan backslope, and is in the north-south extension of Rotsi and the Pudu River hostage to the main tectonic fracture belt. The project is located in the western part of the Yangzi quasi-terrane. Roots fracture to the west for the Wuding to Shiping rupture Luquan fracture concave, Pudu River fracture to the east of the Kunming Taiwan fold bundle of Songming Taiwan concave. The tectonic trace is dominated by rupture, followed by folds. No adverse geological phenomena such as landslides, mudslides, dangerous rock collapses, etc. have been found in the area, and no geologic hazards and adverse geologic effects such as karst, geologic fissures, mudslides, landslides, etc. have been found in the site.

Atmospheric environment. According to the Bulletin of Ecological and Environmental Conditions of Kunming City in 2022, Dongchuan District, Jinning District, Anning City, Songming County, Shilin County, Fumin County, Yiliang County, Luquan County, and Xundian County have a total of 9 automatic air monitoring stations (including 1 reference point), and evaluated according to the Ambient Air Quality Standards (GB3095-2012), in 2022, the 8 counties (cities) under the jurisdiction of Kunming City: Dongchuan District, Anning City, Jinning District, Songming County, Shilin County, Fumin County, Yiliang County, Xundian County, and Yangzonghai Scenic and Historic Spot, the annual average concentrations of sulfur dioxide, nitrogen dioxide, respirable particulate matter, and fine particulate matter will reach the secondary standard. Therefore, the city of Anning is an ambient air quality standard.

Water Environment. The main rivers with close distribution of surface water bodies around the Project are Jiulong River and Longfengqing stream, which are tributaries of the Mantis River and belong to the Jinsha River water system in the Mantis River Basin. According to the "2022 Kunming Ecological Environment Quality Status Bulletin", the water quality category of Mantis River-Pudu River Fumin Bridge section is Class V, and the surface water meets the standard. Groundwater quality around the construction project site meets the requirements of water function zoning.

Acoustic environment. The project is located in Anning Industrial Park, and there is no acoustic environmental protection target within 50m outside the factory boundary.

Soil environment. The status quo of soil environment quality in and around the

project area is good. All indicators can meet the control value of the second category of land in the "Soil Environmental Quality Standards for Construction Land Soil Pollution Risk Control Standards (Trial)" (GB36600-2018).

4.6 Recovery and Utilization of Yellow Phosphorus Tail Gas for Power Generation Project

4.6.1 Socio-economic

The main purpose of this project is to enhance the utilization rate of yellow phosphorus tail gas, and the equipment configuration mainly consists of two special high-temperature and high-pressure yellow phosphorus tail gas boilers, i.e., 2×75 tons per hour high-temperature and high-pressure yellow phosphorus tail gas boilers, 2 sets of 20MW extractive-condensing turbines, 2 sets of 20MW generators, 4,900m³ yellow phosphorus tail gas cabinets and DCS systems, flue-gas treatment devices as well as chemical water treatment devices.

The project is located at the southeast end of Panzhihua City, Panzhihua Vanadium and Titanium Hi-Tech Industrial Development Zone, Madianhe Area, the park is 6km from Jinjiang Town of Panzhihua City in the north, and 25km from Bingcaogang of Panzhihua City in the center, and the Chengkun Railway passes through the park from the north to the south from the east of the park. The Chengkun Railway runs from north to south in the east of the park. The Chengkun Expressway passes through the park 1km to the northwest of the park; Panzhihua Airport is about 4.5km away from the park in a straight line in the northwest direction of the park.

Panzhihua is located in the junction of Sichuan and Yunnan in southwest China, with latitude 26°05′~27°21′ north and longitude 101°08′~102°15′ east. The Jinsha River and Yalong River meet here. To the east and north, it borders with three counties of Liangshan Yi Autonomous Prefecture in Sichuan Province, namely Huili, Dechang and Yanyuan, and to the west and south, it borders with three counties of Yunnan Province, namely Ninglang, Huaping and Yongren. 749 kilometers from Chengdu in the north, 351 kilometers south of Kunming, is the nearest point in Sichuan Province to South China, Southeast Asia along the border, the coastal ports, for the "South Gateway to Sichuan" on the important transportation hub and distribution of trade and materials. The city's administrative area of 7414 square kilometers, jurisdiction over the East District, West District, Renhe District and Miyi County, Yanbian County, with a resident population of 1.216 million, the industrialization rate of 47.4%, the

urbanization rate of 69.92%. 2022, the city's gross domestic product of 122.052 billion yuan, the per capita disposable income of urban and rural residents amounted to 50,009 yuan, 23,364 yuan respectively.

4.6.2 Environmental

Geomorphology. The project site is located in the right bank of Jinsha River valley slope, geomorphology belongs to the tectonic denudation cutting table-like mesa geomorphology. The original topography is high in the west and low in the east, inclined to the Jinsha River valley, with a slope of 10~15°, and the original ground elevation ranges from 1195.47~1215.70m, with a difference of 20.23m. After the preliminary site leveling construction, the site has formed a wide platform with an elevation of 1200m, and a retaining wall has been set up around the site to support it. The rock and soil layers of the survey site are mainly composed of the artificial accumulation layer of the Holocene System of the Fourth Department, the moraine and ice-water deposition layer of the Second Ice Age of the Fourth Department, the residual layer of the Fourth Department, and the mudstone of the Big Turnip Group of the Triassic System. The project site is located in the middle of Sichuan-Yunnan north-south tectonic belt, in the north-south deep rupture and early east-west fold composite parts, the regional tectonic shape is extremely complex. Although the peripheral rupture structure of the project site is developed, there is no rupture passing through the site, and no earthquakes of magnitude 7 or above have occurred in or near the site.

Climate and meteorology. Panzhihua belongs to the South subtropical dry river valley climate zone, with typical South subtropical dry monsoon climate characteristics, warm winter, high spring temperature, cool summer and autumn; small annual difference in temperature; strong solar radiation, abundant sunshine, abundant heat, four seasons; dry and rainy seasons are clearly defined, dry season evaporation is large, the rainy season is concentrated, rainfall, rainfall, more night rains, thundershowers; the regional microclimate is complex and varied, heat and rainfall are unevenly distributed. From low altitude to high altitude is a three-dimensional distribution of climate characteristics.

Hydrogeology. The project site is located in the right bank of Jinsha River Canyon slope area, the terrain of the west high east low. Panzhihua rainy season prevails easterly winds, the site area for the windward slope, warm and humid air flow by the topography

of the obstruction of the uplift and cooling, easy to become a cloud to rain, for the rainfall is relatively concentrated area. The amount and duration of rainfall on windward slopes are more than that on leeward slopes or in other areas, resulting in more rainfall in this area than in other areas of the city. Groundwater types include loose pore water of the Quaternary System and weathered fissure water of clastic rocks. There are no natural poor quality water and the resulting endemic diseases and other primary environmental hydrogeological problems in the project area, and the monitoring of the current environmental status shows that the current status of the groundwater environment around the project is good.

Water Environment. According to the 2022 Panzhihua City Environmental Condition Bulletin, the water quality status of Jinsha River, Yalong River, Anning River and Panzhihua section of Xinzhuang River is excellent. Among the 10 surface water monitoring sections in Panzhihua City, the water quality of Longdong, Tomson, Yalong River mouth, Ertan, and Baizhi sections is excellent, with a water quality category of I. The water quality of Jinjiang, Dawanzi, Xijie Bridge, Wantan Power Station, and Guanyinyan sections is excellent, with a water quality category of II.

Air Environment. According to the "2022 Panzhihua City Ecological and Environmental Conditions Bulletin", the overall air quality in the urban area: 365 days of routine monitoring of ambient air quality in Panzhihua City in 2022, the primary pollutant is ozone, the range of ambient air quality index is 25~108, the annual air quality is excellent for 164 days, good for 198 days, mildly polluted for 3 days, with an excellence rate of 99.2%. Pollutant concentrations in urban areas: sulfur dioxide (SO_2) annual average concentration of 21 μg per m^3; nitrogen dioxide (NO_2) annual average concentration of 29 μg per m^3; respirable particulate matter (PM_{10}) annual average concentration of 46 μg per m^3; fine particulate matter ($PM_{2.5}$) annual average concentration of 28 μg per m^3; ozone (O_3) day maximum 8-hour sliding scale average of the 90th percentile of 126 μg per m^3; and the 95th percentile of the daily average concentration of carbon monoxide (CO) is 2.1 mg per m^3. The project area is located in Panzhihua City, which will be in the attainment zone in 2022.

Soil Environment. According to "2022 Panzhihua City Ecological Environment Status Bulletin", 82 suspected polluted sites in Panzhihua City in 2022, have completed the preliminary soil survey, the city's polluted sites are now a total of 59 are strictly controlled, the city's construction land contaminated site environmental control rate of

100%, the safety of the utilization rate of 100%. The project is located in the area of soil monitoring indicators are satisfied with the "soil environmental quality construction land soil pollution risk control standards (for trial implementation)" (GB36600-2018) the second category of land screening value standards, the regional environmental quality is good.

Acoustic environment. According to the 2022 Panzhihua City Ecological Environment Status Bulletin, the average value of urban regional environmental noise (daytime) in Panzhihua City in 2022 was 52.6 dB, which reached the limit of Class II standard of Acoustic Environment Quality Standard (GB3096-2008). The status quo of acoustic environment quality in the project area is good, and the daytime and nighttime noise meets the requirements of Class III standard of Acoustic Environment Quality Standard (GB3096-2008).

5. Environmental and Social Risks and Impacts

5.1 Assessment Methodology

5.1.1 Risk level Assessment Methodology

This chapter provides an assessment of the potential environmental and social impacts of the six demonstration projects to be implemented. As required by the United Nations Development Programme, the project underwent an initial social and environmental screening process (SESP) and identified a number of socially and environmentally relevant risks, and the project's SESP checklist provided the information on which the impact assessment was based.

An impact is essentially any change in a resource or receptor due to the presence of a project component or the implementation of a project-related activity. For this ESIA report, the impact assessment will be conducted through an iterative process that considers three key factors:

(1) Predicting potential impacts and their magnitude (i.e., the impacts of development on the natural and social environment);

(2) Assessing the risk (or significance) of potential impacts, taking into account the sensitivity of environmental resources or human receptors.

(3) Development of mitigation measures to avoid, minimize, or manage potential impacts, or development of enhancement measures to increase positive impacts.

Environmental and social impacts include the following: (1) nature of the impact: positive or negative; (2) type of impact: direct, indirect, or cumulative; (3) duration of

the impact: temporary, short-term; and (4) scale of the impact: on-site, local, regional, national, international.

In accordance with international best practices, this ESIA will establish a "significance" level for each identified risk/impact. The criteria for assessing the significance of impacts will be derived from the following key elements:

(1) Compliance with relevant host country legislation (i.e., the People's Republic of China), UNDP SES standards/requirements, and international best practice standards and guidelines;

(2) The magnitude (including nature, scale and duration) of changes in the natural or socio-economic environment, expressed quantitatively where feasible. The magnitude of all impacts from the perspective of those affected by considering the likely perceived significance as understood through stakeholder engagement.

(3) The nature and sensitivity of the impact receptor (physical, biological, or human). If the receptor is physical, the assessment considers the quality, sensitivity to change, and significance of the receptor. In the case of human receptors, the sensitivity of the household, community or wider social group is considered, as well as their ability to adapt to and manage the impact.

(4) The likelihood (probability) that the identified impact will occur. This is an estimate based on experience or evidence of what has happened before.

(5) Significance is a function of the magnitude of the impact and the likelihood of the impact occurring. For this assessment, significance will be defined according to the following levels (specified by the SES of the UNDP). When the probability and consequences of an impact are combined, a significance value (low, moderate, substantial or high) can be determined for each risk.

Table 5-1 Probability/likelihood rating of risk

Score	Rating
5	Very High
4	High
3	Medium
2	Low
1	Slight

Table 5-2 Assessing the consequences/Impacts of risks

Score	Rating	Definition

5	Critical	Significant adverse impacts on human populations and/or environment. Adverse impacts high in magnitude and/or spatial extent (e.g. large geographic area, large number of people, transboundary impacts, cumulative impacts) and duration (e.g. long-term, permanent and/or irreversible); areas impacted include areas of high value and sensitivity (e.g. valuable ecosystems, critical habitats); adverse impacts to rights, lands, resources and territories of indigenous peoples; involve significant displacement or resettlement; generates significant quantities of greenhouse gas emissions; impacts may give rise to significant social conflict
4	Severe	Adverse impacts on people and/or environment of medium to large magnitude, spatial extent and duration more limited than critical (e.g. predictable, mostly temporary, reversible). The potential risk impacts of projects that may affect the human rights, lands, natural resources, territories, and traditional livelihoods of indigenous peoples are to be considered at a minimum potentially severe.
3	Moderate	Impacts of low magnitude, limited in scale (site-specific) and duration (temporary),can be avoided, managed and/or mitigated with relatively uncomplicated accepted measures
2	Minor	Very limited impacts in terms of magnitude (e.g. small affected area, very low number of people affected) and duration (short), may be easily avoided, managed, mitigated
1	Negligible	Negligible or no adverse impacts on communities, individuals, and/or environment

Impact	**5**	M	S	S	H	H
	4	L	M	S	S	H
	3	L	M	M	M	S
	2	L	L	L	M	M
	1	L	L	L	L	L
		1	**2**	**3**	**4**	**5**
		Likelihood				
Low, Moderate, Substantial, High						

Figure 5-1 Determining the 'Significance' of Risk Matrix

5.1.2 Life Cycle Assessment Methodology

As defined in the international standard ISO 14040:2006 "Environmental Management: Principles and Framework for Life Cycle Assessment (LCA)", LCA is "the compilation and evaluation of inputs, outputs and their potential environmental impacts over the life cycle of a product system, comprising four interrelated and iterative steps: determination of purpose and scope, inventory analysis, impact assessment and interpretation of results, Impact Evaluation and Interpretation of Results. This report utilizes the LCA approach to assess the environmental and social impacts of the six proposed projects. Specific steps include (Figure 5-2):

(1) Determination of the objective and scope of the assessment: the objective of the

assessment in this report is to determine the environmental impacts of the six proposed projects, and the scope of the assessment is the six demonstration projects;

(2) Research on project data and information: During the assessment process, reference was made to the implementation programs, environmental impact assessment reports, and energy conservation assessment reports of the six proposed projects;

(3) Determination of comparative objects: Around the life cycle of the PCI, from several key links, such as phosphorus ore mining - phosphorus ore flotation - phosphoric acid preparation - industrial application of phosphorus products, etc., the The objects of comparative analysis are identified. The objects of comparative analysis are six demonstration projects, and the potential environmental and social impacts of the six projects are analysed by comparing them with traditional technologies. the six demonstration projects correspond to different links of the phosphorus chemical industry chain (Fig. 5-3).

(4) Establishment of life cycle inventory: Compare the six demonstration projects with the traditional process flow, and establish the environmental impact inventory of different processes respectively;

(5) Comparison and analysis of the inventory: from the perspectives of environmental impacts and greenhouse gas emissions, compare and analyse the emissions of the demonstration projects compared with the traditional processes, and analyse the possibility of further improvement of the demonstration projects;

(6) Comprehensive evaluation of environmental impacts: summarize the six demonstration projects and evaluate the overall environmental impacts of the demonstration project on energy saving and green low-carbon upgrading of the PCI chain.

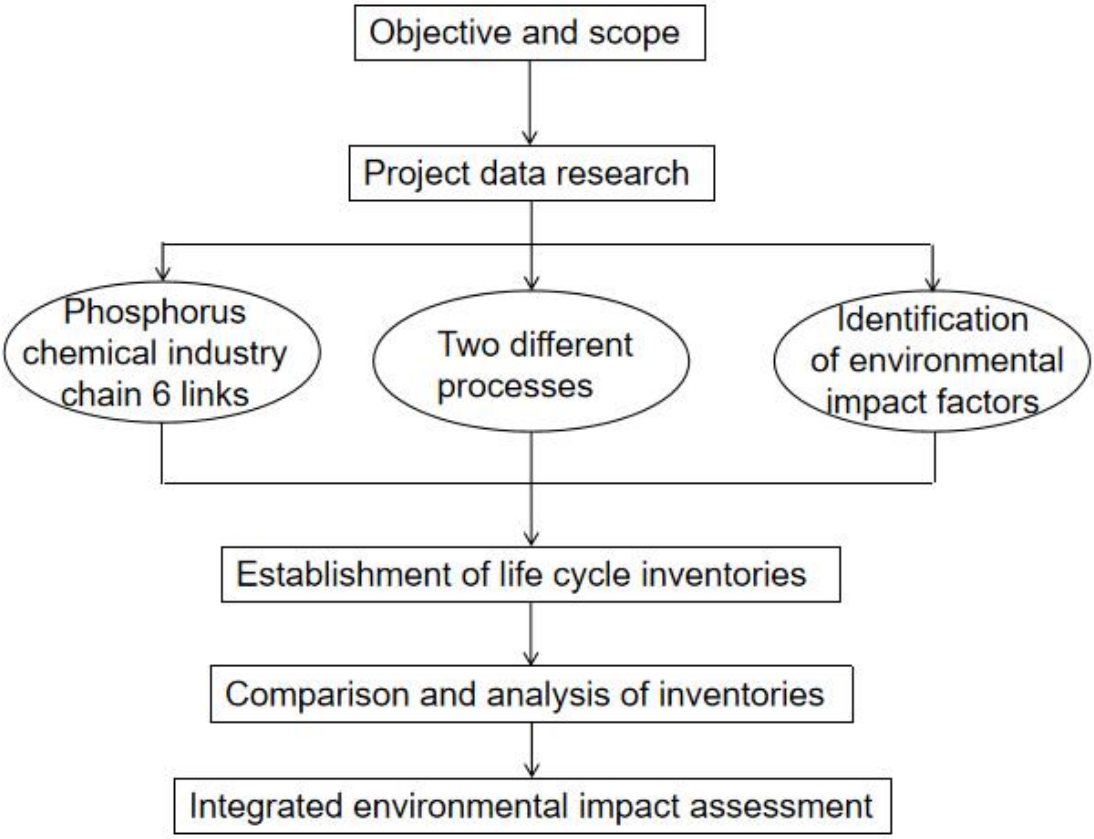


Figure 5-2 Life cycle assessment analysis steps

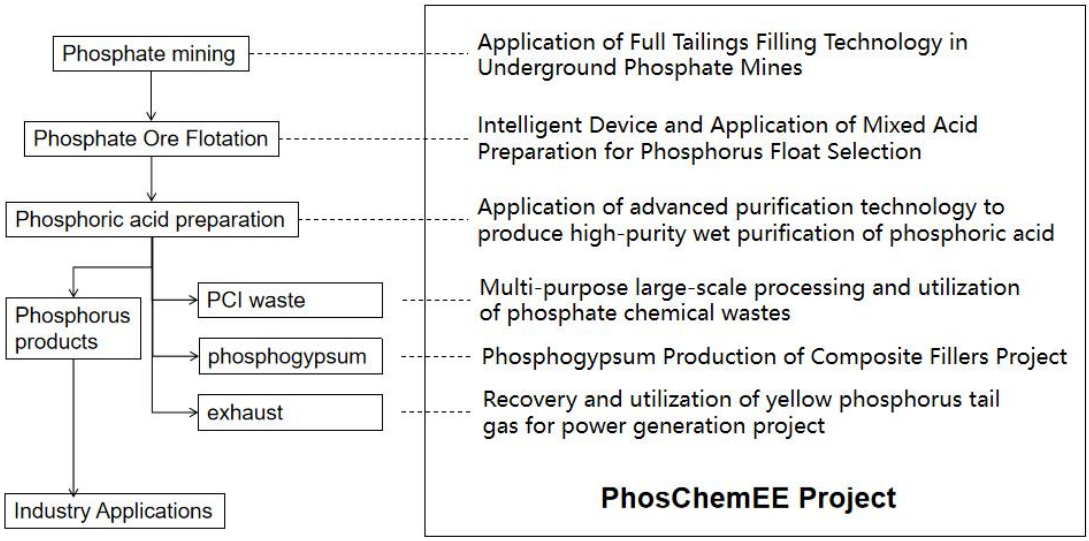


Figure 5-3 Position of the demonstration projects in the PCI chain

5.2 Environmental Risks

The ESIA will conduct an analysis of viable alternatives to the project, comparing

their potential social and environmental impacts. The baseline data referred to in this ESIA can be understood to some extent as an alternative. Therefore, it will be divided into two parts: risk assessment and baseline comparison.

5.2.1 Threats to Conservation of Biodiversity/Natural Habitats

From the analysis of the whole life cycle of the phosphorus chemical industry, the phosphoric acid production in the midstream and the by-product comprehensive utilization projects such as phosphogypsum and yellow phosphorus tailing in the downstream are all concentrated in industrial parks, and there are no special ecologically sensitive areas in the area where they are situated, so that the salient waters that are threatening to the protection of biodiversity/natural habitats are low in general, whereas the phosphorus development link in the upstream, due to its open mining, may have an impact on the ecological environment in the construction area or along the transmission pipeline. area or the ecological environment along the transmission pipeline.

Guizhou Wengfu (Group) Co., Ltd. There are no scenic spots, nature reserves, cultural relics protection zones and water source protection zones within 2,500m around the ore dressing plant, within 500m around the tailing pond construction area and its surroundings, within 2,000m downstream and within 200m on both sides of the concentrate conveying pipeline of this project. There are no rare and endangered animals that need to be protected in the project area, and there are no special ecologically sensitive areas. The soil along the transmission pipeline is dominated by yellow loam and limestone soil, the natural vegetation is dominated by white oak, cycad, thatched oak, and the farmland vegetation is dominated by rice and rape. Therefore, once the transmission pipeline ruptures, it will harm the tree and shrub vegetation along the route, and the woodland vegetation within the soil contamination area will be damaged, which will in turn affect the ecological environment of the woodland along the route. In summary, the likelihood of impacts on biodiversity/natural habitat conservation has been assessed as 'Medium' and the consequence level has been categorized as 'Moderate'. Therefore, the overall significance level of these impacts on biodiversity/critical habitat is categorized as "Moderate".

Sichuan Development Tianrui Mining Co., Ltd.. Mabian County has rich natural resources, the county has a forest area of 159.33km^2, forest coverage rate of 44.2%, crop production of corn and potatoes, cash crops have tea, bamboo shoots, sour plums,

Chinese herbs, pandas, golden monkeys, giant salamanders and other rare animals. The construction of this project is within the area of the selection plant, which is on the industrial land that has been approved, does not occupy agricultural land and pasture land, and covers a small area, the ecological environment is affected by man-made factors, and there is relatively little native vegetation, so the impact of the project occupying the land on plant species is very small, and it will not cause any fundamental change to the composition and system of plant species in the area, and it will have less impact on the woodland of the natural protection forest project. The impact on the rare wildlife and natural ecosystem of this nature reserve is small and will not affect the ecological function of the reserve. The likelihood of the project's impacts on biodiversity/natural habitat conservation has been assessed as "Medium" and the consequence level has been categorized as "Minor". Therefore, the overall significance level of these impacts on biodiversity/critical habitat is categorized as "Low".

Guizhou Kailin Mining and Fertilizer Co., Ltd.. The ecological impact of the project on the surrounding environment is mainly in the operation period. The negative impact of the construction project on the regional ecological environment during the operation period is mainly the impact of pollutants in the external exhaust on the regional vegetation and crops. As the project is a fine chemical industry, the emission of disorganized exhaust gas affects the yield and quality of the surrounding crops. When it comes into contact with plants, spots will be produced on the leaf surface, and the affected crops include hollow cabbage, spinach lettuce and so on. When wheat, rice and corn are poisoned by fluoride and hydrogen sulfide, the plants are stunted, the root system is underdeveloped, the photosynthesis ability is weak, the absorption of water and nutrients is blocked, and the seed filling is poor; when vegetables such as cabbage, cucumber, radish and beans are poisoned by fluoride and hydrogen sulfide, the plants are short, the leaves are narrow and gray, the root system activity and aboveground growth are seriously inhibited and lead to a reduction in yield. In summary, the project's main air pollutants fluoride, hydrogen sulfide and other impact on crops is significant. Therefore, measures must be taken to reduce the unorganized emissions of organic pollutants. The project proposes to collect and purify the process tail gas of fluoride and hydrogen sulfide centrally and then discharge it at high altitude, which can reduce the impact of disorganized emission on crops.

Yunnan Phosphate Chemical Group Co., Ltd. This project is located in Yunnan

Phosphorus Chemical Group's existing site, for the technical transformation project. For the current P_2O_5 content of about 7.0% of phosphorus tailings characteristics, to carry out comprehensive utilization of phosphorus tailings research and study, in order to get the phosphorus tailings resource utilization of effective ways to ensure that the phosphorus tailings can be reasonably industrialized use, consumption of new phosphorus tailings, extend the service life of tailings storage, improve the utilization of phosphorus resources, and ultimately achieve the full amount of phosphorus resources resource utilization, for China's comprehensive utilization of phosphorus tailings to provide industrialization and application demonstration. Application demonstration. The project does not add new production scale, and the threat to biodiversity/natural habitat protection is small.

Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.. The temporary storage site of phosphogypsum, production area and transmission pipeline of this project are all within the industrial park, and the vegetation in the pipeline area of this project is mostly secondary woodland and farmland vegetation, and there are fewer animal species and numbers in the evaluation area, and the animal species are mainly small birds, beasts and amphibians, such as sparrows, voles, frogs and so on. No rare and endangered and key protected wild animals are found in the area, and there are no scenic spots and nature reserves around the project. Therefore, the construction of the project will not have significant adverse impacts on the species diversity in the region. In summary, the likelihood of the project's impacts on biodiversity/natural habitat conservation is assessed as "Slight" and the consequence level is categorized as "Minor". Therefore, the overall significance level for these impacts on biodiversity/critical habitat is categorized as "Low".

Zhonglicheng Industrial Co., Ltd.. The project area is characterized by a lack of biological resources and is essentially devoid of forests, with a very small amount of sour horn, bamboo, sisal, yellow jacaranda, green kangaroo tree, red heart fruit and prickly horn scattered throughout the park. The whole area is covered with barren slopes (e.g. thatch) and bare rocks, except for newly opened wasteland planted with vegetables and fruit trees. The project site is the company's existing plant, and the plant area is greened with evergreen trees or grass planting, except for the production area, the comprehensive auxiliary area and the road hardening area. There is no need to protect rare and endangered animals in the project area, and there is no special ecologically

sensitive area. In summary, the likelihood of the project's impacts on biodiversity/natural habitat conservation has been assessed as "Slight" and the consequence level has been categorized as "Minor". Therefore, the overall significance level of these impacts on biodiversity/critical habitat is categorized as "Low".

Table 5-3 Statistics on the level of risk to biodiversity/natural habitats by project

Demonstration Site	Site Type	Major influence	risk level
Guizhou Wengfu (Group) Co., Ltd	Open-pit phosphate mine	The area where the project is located does not need to protect rare and endangered animals, and there are no special ecologically sensitive areas. However, once the rupture of the concentrate transportation pipeline occurs, it will harm the tree and shrub vegetation along the route, and damage the woodland vegetation within the scope of soil contamination, which will in turn affect the ecological environment of the woodland along the route.	Moderate
Sichuan Development Tianrui Mining Co., Ltd.	Open-pit phosphate mine	The new beneficiation areas are all within the red line of the industrial site of the existing beneficiation plant project. There are no famous and ancient trees and rare wild animals and plants that need special protection under national regulations within the occupied area of the project industrial site. There are no ancient tombs, ancient temples and other cultural relics within the project area.	Low
Guizhou Kailin Mining and Fertilizer Co., Ltd.	Industry Park	The project area is not required to protect rare and endangered animals, and there are no special ecologically sensitive areas.	Low
Yunnan Phosphate Chemical Group Co., Ltd.			
Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.			
Zhonglicheng Industrial Co., Ltd.			

5.2.2 Pollution and Waste Emissions

From the perspective of the full life cycle analysis of the phosphorus chemical industry, the upstream phosphorus mine development project will cause a certain degree of pollution to surface water, groundwater and soil due to the risks of pipeline rupture and leakage, tailings pond collapse and so on. The midstream phosphoric acid production and the downstream phosphogypsum, yellow phosphorus tailing and other

by-products comprehensive utilization projects are concentrated in industrial parks, and the overall level of environmental risk of pollution and waste discharge under normal operation is low.

(1) Guizhou Wengfu (Group) Co., Ltd

1)Risk assessment

Air pollution. According to the analysis of engineering emissions, the main source of exhaust gas generated by the project is the dust emitted during the production process of the ore dressing plant, in addition, there is a small amount of unorganized dust emission during the mixing process of the tailings filling system, which has little impact on the regional ambient air quality. In summary, the possibility of the project's impacts on the air environment is assessed as "Slight", and the consequence level is categorized as "Minor". Therefore, the overall significance level of these impacts on air pollution is categorized as "Low".

Water Pollution. The production wastewater of this project is mainly tailing water of Xinlongba processing plant and Machangping concentrate dewatering backwater, with a production volume of 24,207.1m^3/d, all of which are returned to the processing plant for utilization and not discharged externally, which has a relatively small impact on the external environment. Tailings filling system production wastewater is reused for filling system production water or washing water after precipitation treatment. Domestic wastewater mainly comes from Xinlongba dressing plant, phosphate concentrate conveying backwater project, phosphate concentrate dewatering and loading project and tailings filling system project, with an amount of 15.91m^3 per day, all of which are utilized after biochemical treatment and not discharged, with small impact on the external environment. Under normal production conditions, all tailings water is returned to the concentrator for utilization, with zero wastewater discharge; under extremely adverse weather conditions, there are tailings pond upstream water and tailings pond wastewater accumulation, tailings water in the pond enters into the tailings dam downstream backwater adjustment pool through the overflow tower-tunnel, and in general all tailings water is transported to the concentrator high level pool by the backwater pump as the production water of the concentrator. In the case of extremely adverse weather conditions when the backwater adjustment pool can not be satisfied, or the tailings storage dam failure damage, wastewater discharge will have a certain impact on the water quality of the Baiyan River. Tailings' wastewater mainly affects the water

quality of the river, causing fluoride, ammonia nitrogen, phosphate, COD, as to exceed the standard. Any rupture of the concentrate and return water transportation pipeline will cause serious pollution accidents to the water bodies along the route. The project's pollution pathway to groundwater mainly comes from the plant and pipeline running, bubbling, dripping, leaking sewage through the soil layer infiltration, pollution of groundwater as well as the impact of the seepage of pollutants from the temporary storage sites of raw and auxiliary materials, products, solid wastes and other pollutants. Under normal production conditions, the project has little impact on the plant area and nearby groundwater environment. Under abnormal conditions, there are unorganized leakage of equipment and other ways of unorganized discharge in the installation area of Xinlongba Ore Dressing Plant and Machangping Phosphate Fertilizer Plant, and there is even the possibility of accidental discharge due to natural disasters and man-made factors, and the accidental situation produces wastewater and toxic and harmful materials that can pollute the groundwater of the area of the plant site through the role of seepage. The project is located in the area of deep underground diving, bedrock overburden, except for the steep ditch, gully and other parts of the thin clay sandwiched gravel, are red clay, for a good natural water barrier and seepage control layer, so the installation area and pipeline projects under abnormal conditions have little impact on the groundwater environment. In conclusion, the possibility of the project's impact on the water environment is assessed as "Medium", and the consequence level is categorized as "Moderate". Therefore, the overall significance level for these impacts on water pollution is categorized as "Moderate".

Solid Waste Pollution. Solid wastes of this project are mainly crushing and screening recovery dust of the ore dressing plant, tailings generated by the flotation workshop, and living garbage in the living area. The crushing and screening recovery dust of the ore dressing plant is used as raw material to return to production; the tailings generated by the flotation workshop belong to Class I general industrial solid waste, with an amount of 1774080 tons per year, which will be discharged in the form of slurry and disposed of in Baiyan tailings storage, and the amount of living garbage generated is 35.31 tons per year, which will be disposed of in accordance with the requirements of the local sanitation department after unified collection. In summary, the solid waste disposal rate of this project reaches 100%, which has little impact on the environment. In summary, the possibility of the project's impact on solid waste is assessed as "Slight",

and the consequence level is categorized as "Minor". Therefore, the overall significance level for these impacts on solid waste pollution is categorized as "Low".

Soil Pollution (Erosion). The total amount of soil erosion in the project area is 430,700 tons, and the amount of new soil erosion is 25,600 tons.The key area of soil erosion is the tailing pond, and the key time is in the production and operation period. If the rupture of concentrate slurry transportation pipeline or backwater pipeline occurs, it will have pollution impact on the soil along the route. In summary, the potential of the project to affect the soil environment is assessed as "Medium", and the consequence level is categorized as "Moderate". Therefore, the overall significance level of these impacts on noise pollution is categorized as "Moderate".

Noise Pollution. There is one resident within 200m of Xinlongba Concentrator on the south side, and Matian Village is 110m on the north side. The rest of the residents are far away from the site, and the noise impact of the project is relatively small. Machangping phosphate fertilizer plant site is similar to trapezoidal, the project does not add new land, in the existing plant in the middle of the layout, distance from the east, west and north of the plant boundary are greater than 200m, and in the middle of the plant buildings are separated, the noise impact is small. In summary, the possibility of the project's impact on the acoustic environment is assessed as "Slight", and the consequence level is categorized as "Minor". Therefore, the overall significance level of these impacts on noise pollution is categorized as "Low".

2) Baseline Comparison

This project is a reconstruction and expansion project, compared with the pre-reconstruction, this project does not add new pollutant emissions, and at the same time can improve the comprehensive utilization efficiency of resources.

The project adopts re-election and regrinding, flotation production process to improve the comprehensive utilization rate of ore resources, and the total recovery of phosphorus reaches 96.84%. In terms of comprehensive utilization of wastewater, the acidic water and phosphate concentrate slurry produced by Machangping phosphate fertilizer plant will be dewatered and transported to the beneficiation plant for utilization, which will save 2,429,300 m^3 per year of fresh water annually, recover 5,769.4 tons per year of phosphorus (in terms of P_2O_5), and save 32,000 tons per year of sulfuric acid, and the direct economic benefits are estimated at 42 million RMB per year (refer to the sulfuric acid of 700 yuan per ton, and the phosphorus fertilizer of 3,400 yuan per ton).

After the completion of the project, the water reuse rate of the whole plant is 95.0%, effectively realizing the comprehensive utilization of water resources and "zero" discharge of industrial wastewater.

(2) Sichuan Development Tianrui Mining Co., Ltd.

1) Risk assessment

Atmospheric pollution. The plant adopts conventional flotation beneficiation process, which requires the addition of chemicals in the beneficiation process, and the tailings will inevitably contain a small amount of residual beneficiation chemicals, which are volatile, so the impact on the surrounding environment is relatively small. Because the tailings are filled and discharged, therefore, the impact on the surrounding environment is small.

Water pollution. Wastewater generated by the project includes ore dressing wastewater and tailings wastewater. The production wastewater of the ore dressing plant is mainly concentrate, tailings concentration overflow water, etc., and the amount of wastewater is about 28,570m^3 per day. The ore dressing wastewater is recycled in the ore dressing plant, and under normal circumstances, there is no production wastewater discharged except for part of the natural evaporation loss. Tailings are transported to the tailings filling station after thickening, and the tailings enter the underground filling station after high efficiency thickening, and the volume of tailings filling is 205m^3 per hour, and the volume of backwater is 58m^3 per hour, all of which are sent to a section of the mill for secondary use, under normal circumstances, there is no production wastewater discharged.

Solid waste. The solid waste generated by this project is mainly a very small amount of phosphogypsum in the process of acid mixing, entering the flotation process in the state of slurry, and finally entering the concentrate slurry, dewatering, and then processing the concentrates in the way of export, without the need for external transportation to deal with it separately.

Noise Pollution. In order to reduce the noise pollution generated during the production process of this project, the project will try to arrange the noisy mixed-acid preparation station plant near the center of the plant and far away from the plant boundary and sensitive protection targets during the layout of the plant. On the basis of meeting the needs of the process, the equipment selection is based on the selection of low-noise equipment. Noisy places are installed with sound insulation doors and

windows, and the protection distance is reserved with the protection targets and plant boundaries. The noisy fans and pumps are installed with mufflers, acoustic enclosures and other noise reduction equipment to minimize noise. Through the above noise reduction measures, the project can make the noise at the factory boundary reach the standard, and the impact on the surrounding environment is very small.

2) Baseline Comparison

Ltd. is located in Mabian County, Leshan City, Sichuan Province, where there are rich phosphate resources, the original properties of the ore for the gum phosphorite, mainly phosphate composition, containing a small amount of Si, A1, Fe, K, Mg and other elements, of which the average content of Mg0 is about 5-8%, so the local processing plant are used in the removal of magnesium to increase the phosphorus, a single reverse flotation process. The existing beneficiation system of Tianrui Mining Plant adopts single reverse flotation, magnesium and phosphorus removal and beneficiation process, and the system flow includes two closed-circuit crushing of raw ore, two closed-circuit ball milling, two sweeps of flotation for one coarse and one fine, thickening of concentrate tailing, dewatering of concentrate, and tailing charging. Among them, the flotation process is the core part of the beneficiation process, which is the key transformation link of this project.

The existing production system uses concentrated sulfuric acid dilution device set up in the production site, the acid mist generated to a certain extent on the site operators mechanical and electrical equipment will have an impact on the project to collect and utilize these substances to reduce the pollution of the atmosphere; through technological research and development and innovation, to reduce the consumption of raw materials, and accordingly reduce the raw materials in the production and manufacturing process of carbon emissions. The project design strictly implements the requirements of chemical design specifications, effectively controls the harmful gases generated during operation, sets up induced draft fan, scrubbing tower, venturi and other devices for full scrubbing and collection, effectively solves the problem of environmental pollution, and recycles the harmful substances in the gas to the ore dressing production, which meets the national emission standards. Through the implementation of the project, it is planned to improve the yield of phosphate ore by 1.5% and the production rate by 3.4% in 2024; it is planned to improve the yield by another 2.9% and the production rate by another 1.5% in 2025; and it will steadily increase the annual yield of concentrates by 29,000

tons compared with that of the year of 2023, which is equivalent to the reduction of the consumption of raw ore resources by 42,000 tons. Raw materials and products under the same conditions, to achieve the purpose of energy saving and consumption reduction in the production of the plant, to maximize the use of resources and effective protection of the environment.

Table 5-4 Project resource and environmental benefits

serial	Year	Raw ore feed (tons)	Raw Ore Grade (%)	Fine Ore Grade (%)	Tailings grade (%)	Recovery rate (%)	Yield (%)	Planned Raw Ore Acid consumption(kg per ton)	Planned Fine Mineral Production (tons)	Recovery of more fine ore compared to the previous year (tons)
1	2021	39	23.1	29.5	7.8	89.9	70.3	32	29.03	--
2	2022	113	20.5	28.4	6.9	86.6	61.1	30	66.9	--
3	2023	135	20.5	28.6	6.5	88.5	64.4	30	87	--
4	2024	180	21	29	5.8	90.5	65.5	25	117.9	1.4
5	2025	200	21	29	5.5	91.1	66	22.5	131.9	0.9
6	2026	200	21	29	5.3	91.5	66.2	22	132.5	0.6
7	2027	200	21	29	5	92.1	66.7	21.5	133.3	0.8

(3) Guizhou Kailin Mining and Fertilizer Co., Ltd.

1) Risk assessment

Air pollution. Under the normal emission conditions of the project, the short-term concentration of fluoride at the ambient air protection targets and grid points meets the requirements of Class II standard of Ambient Air Quality Standard (GB3095-2012), and the short-term concentration of hydrogen sulfide and TVOC meets the requirements of reference limits of air quality concentration in Appendix D of Technical Guidelines for Environmental Impact Assessment Atmospheric Environment (HJ2.2-2018). The short-term concentration of fluoride after superimposing the background concentration meets the requirements of Class II standard of Ambient Air Quality Standard (GB3095-2012), and the short-term concentration of hydrogen sulfide and TVOC meets the requirements of reference limit value of air quality concentration of Appendix D of Technical Guidelines for Environmental Impact Assessment Atmospheric Environment (HJ2.2-2018), and the maximum landed concentration of fluoride in the area at the protection target does not exceed the requirements of Ambient Air Quality Standard

(GB3095-2012). The maximum concentration of fluoride in the area at the protection target does not exceed the "Ambient Air Quality Standards" (GB3095-2012) secondary standard requirements, and has a greater impact on the environment; the 1-hour concentration of hydrogen sulfide meets the requirements of the "Technical Guidelines for Evaluation of Environmental Impacts The Atmospheric Environment" (HJ2.2-2018) Appendix D Air Quality Concentration Reference Limits, and has a small impact on the environment.

Water pollution. When the production wastewater is discharged into Yangshui River irregularly:The water quality factors of Yangshui River Laojie section (W2) are all exceeding the standard, and the contribution value is larger, so it can be known that the project wastewater is discharged irregularly and has a greater impact on the water quality of Pijia River. Therefore, strengthen the inspection of the plant to ensure that the accident pool is vacant at any time, and the accidental drainage collection facilities are perfect, so that all the accidental drainage can be collected to the accident pool of the plant for treatment in time, and prevent the accidental wastewater from being discharged to Yangshui River. Under abnormal circumstances, pollutants will occur along the impermeability failure of the broken location of continuous leakage of pollutants will have a certain impact on the surrounding groundwater. Therefore, it is possible to have an impact on the groundwater in the local area under abnormal conditions, and it is recommended that the seepage prevention and overhaul of the storage tank area, production area, wastewater collection pool and transmission pipeline and other areas be strengthened to enhance their daily overhaul, maintenance and monitoring, so as to effectively reduce the risk of contamination of the groundwater. The likelihood of the project's impacts on the water environment is assessed as "Medium", and the consequence level is categorized as "Moderate". Therefore, the overall significance level of these impacts on water pollution is categorized as "Moderate".

Acoustic Environment. After the project adopts noise control measures, the contribution of noise sources to the noise of the enterprise boundary is 18B(A)~30dB(A), and the daytime and nighttime noise values of the east, south, west and north plant boundaries of the project meet the Class 3 standard of Environmental Noise Emission Standard for Plant Boundaries of Industrial Enterprises (GB12348-2008), which has a relatively small impact on the acoustic environment within the evaluation area, and will not change the quality of the acoustic environment

in the evaluation area.

Soil environment. After 20 years of operation of the project, the arsenic content in the soil is 20.706mgkg, an increase of only 6.56%, which is relatively small, and at the same time, it does not exceed the requirements of the standard limit of 60mg per kg for the second class of land in the "Soil Environmental Quality Soil Pollution Risk Control Standards for Construction Land (for Trial Implementation)" (GB36600-2018). The operational accidental leakage of the project has a small impact on the soil environment.

2) Baseline Comparison

All the wastewater of this project is reused and not discharged; this project does not involve the emission of NOx and particulate matter, and the emission of VOCs is 6.775 tons per year. Among the characteristic pollutants, the emission of fluoride is 0.857 tons per year, and the emission of hydrogen sulfide is 1.753 tons per year.

The design of this project takes into full consideration of environmental protection factors, the design of the device process takes into account the requirements of clean production, raw material routes, process technology using less polluting, pollutants easy to manage, stable and advanced operation of the process production line, maximize the utilization rate of resources and energy. Through scientific and strict management, pollution is eliminated or reduced as much as possible in the process, so as to fundamentally reduce the emission of pollutants and mitigate the impact on the environment. For the unavoidable pollution generated by the process, the first to take recycling or comprehensive utilization measures, the pollutants discharged to the outside, then take advanced, reliable, economic management measures to meet the national emission standards. The treatment process of pollutants in this project has been tested through actual production, and the pollutant emissions after treatment meet the national emission standards.

(4) Yunnan Phosphate Chemical Group Co., Ltd..

1) Risk Assessment

At present, the main beneficiation process is mainly reverse flotation and scrubbing process, the principle process flow for the raw ore - coarse crushing - medium crushing - fine crushing - screening - grinding - classification - flotation - dewatering, scrubbing beneficiation production capacity of 6.18 million tons per year, flotation production capacity of 7.5 million tons per year, flotation phosphorus tailings production rate of 30%, the main treatment method for the existence of the tailings storage heap. Flotation

phosphorus tailings as bulk industrial solid waste, the mine and its surrounding environment has caused great harm, while restricting the sustainable development of mining enterprises and even the entire phosphate mining industry. Resource utilization of phosphorus tailings can gradually to completely eliminate the safety hazards brought by tailings ponds, and effectively protect the lives and properties of downstream residents. At the same time, phosphorus tailings are used for ecological restoration of the mining area, restoring the surrounding ecological environment and achieving the purpose of integrating into the ecosystem and restoring the land, with better environmental benefits.

The utilization of solid waste resources is closely related to the dual-carbon target, and the conversion of generated solid waste into valuable products or energy can, on the one hand, significantly reduce greenhouse gas emissions, immobilize high-carbon compounds, avoid the direct emission of high greenhouse gas effector (methane, nitrous oxide) gases into the atmosphere, and help the realization of the goal of carbon peaking. On the other hand, through the utilization and transformation of solid waste resources, it improves the way of resource utilization and utilization efficiency, follows the closed-loop production mode, and reduces the carbon emissions during the extraction and production of new resources.

In summary, the project's potential for environmental impacts has been assessed as "Low" and the level of consequence has been categorized as "Minor". Therefore, the overall significance level for these impacts is categorized as "Low".

2) Baseline Comparison

Through the flotation tailings P_2O_5 grade from 7% to 6% of the industrialization of the application of transformation, to achieve the reduction of flotation tailings P_2O_5 grade to less than 6%, improve the concentrate yield rate of more than 1.5%, more than 90,000 tons of recovered concentrates per year, reduce the tailings discharge of 90,000 tons per year, reduce the mining of the original mine of about 130,000 tons per year. Through the research on the application of roadbed materials prepared by phosphorus tailings, finally realize the promotion and application of phosphorus tailings-based building materials in the ecological restoration area of the mine road, country road, roadbed material core compressive strength >15MPa, flexural strength >2MPa, phosphorus tailings brick compressive strength >16MPa, strength performance, environmental protection indexes have met the requirements. Determine the dosage of

phosphorus tailings in building materials products ⩾ 75%, quality indicators to meet GB/T21144-2007 "concrete solid brick". Ultimately, the consumption of phosphorus tailings is ⩾100,000 tons per year. Through the research on innovative key technology and application of calcium and magnesium-rich soil conditioning products, develop green products for agricultural use of phosphorus flotation tailings, and realize the consumption of 100,000 tons of phosphorus tailings and the production of soil conditioning agents and other agricultural products during the project implementation period. Through the phosphorus tailings preparation ecological restoration matrix soil for mine land reclamation research, built 400,000 tons per year phosphorus tailings preparation ecological restoration matrix soil demonstration device, the use of phosphorus tailings not less than 300,000 tons per year.

(5) Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.

1) Risk Assessment

Air pollution. There is no exhaust gas emission from the cement retarder production device of this project. Supporting the new construction of a 5t oil boiler, exhaust emissions of 5100Nm^3 per hour, of which particulate matter ⩽ 30mg per Nm^3, sulfur dioxide ⩽ 200mg per Nm^3, nitrogen oxides ⩽ 250mg per Nm^3. to meet the requirements of the new boiler air pollutant emission standards. A single set (500,000 tons per year) of construction gypsum powder device, calcined boiling furnace emission tail gas is 60,000Nm^3 per hour, the tail gas by the bag filter + double alkali wet desulphurization + air emission, of which particles ⩽ 30mg per Nm^3, sulfur dioxide ⩽ 40mg per Nm^3, nitrogen oxides ⩽ 35mg per Nm^3. from the comprehensive use of the site to the improved phosphogypsum turnover yard using tipper trucks transportation, road surface Repeatedly crushing and generating dust will have little impact on regional air quality. In addition, the hazardous substance involved in this project is diesel fuel. Diesel fuel is stored in one 50m^3 diesel fuel storage tank, and fire accidents occur in the storage tank area, and the accompanying pollutants (SO_2 and NO_2) cause environmental pollution to the atmospheric environment. In summary, the possibility of the project's impacts on the air environment is assessed as "Medium", and the level of consequences is categorized as "Moderate". Therefore, the overall significance level of these impacts on air pollution is categorized as "Moderate".

Water Pollution. The vacuum pump and pump sealing water is collected and returned to Xiangfeng Jinmai Company as clean circulating water station replenishment

water. The filtered dilute phosphoric acid is returned to the phosphoric acid plant to recover P_2O_5, and there is no production wastewater discharged in this project. Domestic wastewater using biochemical treatment + filtration process to remove pollutants in the water, biochemical treatment process using integrated buried domestic wastewater treatment equipment, biochemical treatment of water through a multi-media filter to further remove suspended solids in the water, the filter water meets the discharge standards. The discharge is $0.5m^3$ per hour, as the phosphogypsum rinse water, not discharged. This project involves hazardous substances for diesel fuel storage tank (1, $50m^3$). It is not easy to leak by adopting anti-seepage measures, and it is arranged in the factory area, not easy to spread to the nearby surface water, so the impact on surface water and groundwater caused by leakage accidents is relatively small. In summary, the possibility of the project's impact on the water environment is assessed as "Slight", and the consequence level is categorized as "Minor". Therefore, the overall significance level of these impacts on water pollution is classified as "Low".

Solid Waste Pollution. Solid waste generated by the project mainly includes general industrial solid waste, hazardous waste and domestic garbage. General industrial solid waste mainly consists of plate and frame filter press cake, dust collected by dust collector and coal slag, which are recycled. Hazardous waste is mainly waste engine oil, which is regularly transported and disposed by qualified hazardous waste disposal units. The solid waste disposal rate during the production and operation period of this project reaches 100%, which has less impact on the surrounding environment. In summary, the possibility of the project's impact on solid waste is assessed as "Slight", and the consequence level is categorized as "Minor". Therefore, the overall significance level of these impacts on solid waste pollution is categorized as "Low".

Soil Contamination. The impermeability coefficients of the oil storage tank area, temporary storage area and pool area of this project shall reach the equivalent clay impermeable layer $Mb \geqslant 6.0m$, $K \leqslant 1\times10\text{-}7cm$ per second. Under normal conditions, no surface diffusion will occur, and the impact on the soil will be small. According to the atmospheric prediction, the maximum landfall concentration is small, and the coverage and growth of surface vegetation also directly affects the adsorption of fluoride and phosphorus by the soil, so the impact of atmospheric deposition on the soil environment is small. In summary, the possibility of the project's impact on the soil environment is assessed as "Slight" and the consequence level is categorized as "Minor". Therefore, the

overall significance level for these impacts on noise pollution is categorized as "Low."

Noise Pollution. During the operation period of the project, the main noise sources come from the noise of phosphogypsum temporary storage site machinery operation, improved phosphogypsum transfer vehicle transportation noise (transported within the project area) and production equipment noise in the production area, through the selection of low-noise equipment, production equipment placed indoors, and set up vibration-damping foundations, and greening in the project area, to reduce the noise sources. There is no sensitive point within 50m around the project, so the noise impact of the project on the surrounding environment is small. In summary, the possibility of the project's impact on the acoustic environment is assessed as "Slight", and the consequence level is categorized as "Minor". Therefore, the overall significance level of these impacts on noise pollution is categorized as "Low".

2) Baseline Comparison

This project is mainly a 2 million tons per year phosphogypsum comprehensive utilization project, the construction content includes cement retarder device (phosphogypsum conveying, phosphogypsum concentration, tank area, filtration plant, cement retarder maturation warehouse), construction gypsum powder device, power distribution room, turnover yard, etc. 2 million tons per year of phosphogypsum (dry basis) after pretreatment and purification, 1.5 million tons are sold as a cement retarder, and 500,000 tons are used for calcination to produce construction gypsum powder. production of construction gypsum powder. The construction of this project is in line with the national industrial policy of developing circular economy to realize sustainable development. The process route of this project fully embodies the concept of circular economy and scientific development, and is an environmentally friendly demonstration project of "reduction, reuse and recycling". This project has the advantages of rapid recovery of water-soluble phosphorus, reduce phosphorus loss; improve the quality of cement retarder, to meet the needs of users; prolong the slag storage period, reduce the slag operation costs; reduce the amount of gypsum mining, reduce mining costs; reduce the amount of natural water, the water balance of the system is easy to control and so on.

(6) Zhonglicheng Industrial Co., Ltd.

1) Risk Assessment

Air pollution. The new air pollutants of this project include particulate matter, SO_2,

NO_2, CO, P_2O_5, fluoride, NH_3. The project itself is an emission reduction project, and after the implementation of the reduction program, the annual reduction of particulate matter will be 60t, and the total annual emission will not be more than 16t; the annual reduction of sulfur dioxide will be 1,250t, and the annual emission will not be more than 76t; the annual reduction of nitrogen oxide will be 153t, and the annual emission will not be more than 153t; all other air pollutant emissions can be reduced and discharged in accordance with the standards. The total annual emission after accounting does not exceed 153t; other air pollutant emissions can be reduced and meet the emission standards. Therefore, the air pollutants emitted by this project have little impact on the environment, and under normal emission conditions, it will not lead to the exceeding of the air environment quality in the region and sensitive points, and it will not cause the change of the regional air environment function due to the construction of the project. In summary, the possibility of the project's impact on the air environment is assessed as "Slight" and the consequence level is categorized as "Minor". Therefore, the overall significance level of these impacts on air pollution is categorized as "Low".

Water Pollution. The backwash, reverse osmosis wastewater and recycling station effluent from the project's cogeneration plant wastewater water treatment system are sent to the plant's water purification station for recycling. The process wastewater generated in the clean production area of yellow phosphorus is recycled after sewage treatment in the plant and used as yellow phosphorus process supplementary water without external discharge. The domestic wastewater generated by the new personnel during operation is uniformly collected in the existing plant domestic wastewater treatment system after pretreatment and sent to the park wastewater treatment center for treatment. Therefore, this project does not produce new wastewater discharge and has no impact on surface water. According to the analysis of pollution link, the project may produce pollution structures, accident pool for abnormal conditions of production solution and wastewater temporary storage structures, usually vacant; hazardous waste storage room, warehouse storage of chemicals, finished products, and waste are using the appropriate packaging (such as plastic drums), the occurrence of abnormal conditions of leakage is limited, the formation of hydraulic gradient is small, the possibility of contamination of the groundwater system is relatively small, and the environmental impact assessment requires that the above The EIA requires the above structures to take corresponding measures for seepage prevention and groundwater

environmental protection; after taking corresponding measures, the chances of pollutants seeping down into the aquifer during the operation of the above structures are small. The yellow phosphorus tail gas purification system and slag vapor and slag outlet flue gas collection and treatment system have less impact on the groundwater environment under normal operation. Under abnormal operation state, except for total phosphorus exceeding the standard, fluoride, sulfide, arsenic and cyanide do not exceed the Class III standard in GB/T14848-2017, and there is a certain degree of risk. In summary, the possibility of the project's impact on the water environment is assessed as "Medium", and the consequence level is categorized as "Moderate". Therefore, the overall significance level of these impacts on water pollution is categorized as "Moderate".

Solid Waste Pollution. The project generates general solid wastes such as boiler slag, furnace ash, desulfurization ash, wastewater settling tank sludge, and hazardous wastes such as waste mineral oil. The sludge from the wastewater precipitation tank of the second washing is mixed into the yellow phosphorus slag, which is temporarily stored in the yard together with the slag, and then sold as cement adulterant. The boiler slag, furnace ash and desulfurization ash are temporarily stored in the slag/ash storage, and sold as raw materials for cement, building materials such as bricks/boards, etc. The air filtration waste slag, spent adsorbent and new domestic garbage are handed over to the sanitation department for removal. Hazardous wastes such as waste mineral oil, oiled rags and oiled filter elements are temporarily stored in the hazardous waste storage room of the plant, and will be disposed of by qualified hazardous waste disposal units at regular intervals. Therefore, after the solid waste generated by this project is disposed of by the above disposal measures, the destination is reasonable and clear, and it will not cause secondary pollution and have no obvious impact on the environment. In conclusion, the possibility of the project's impact on solid waste is assessed as "Slight", and the consequence level is categorized as "Minor". Therefore, the overall significance level for these impacts on solid waste pollution is categorized as "Low."

Soil Pollution. The project area is hardened, cofferdams are installed, a complete drainage system is laid out, and regular inspections and electronic monitoring are carried out to prevent wastewater from leaking out, so the probability of impacts on soil is small. In summary, the probability of the project's impact on the soil environment is assessed as "Slight", and the consequence level is categorized as "Minor". Therefore, the

overall significance level of these impacts on soil contamination is categorized as "Low."

Noise Pollution. Noise generated by boilers, turbine generator sets and various auxiliary equipments in the clean production area, such as pumps, fans and other power machinery, and noise generated by the flow of various media in pipelines and exhaust, etc., form an impact on the surrounding environment. The project is surrounded by 200m mainly for industrial enterprises, no residents, schools and other environmentally sensitive protection targets, the project noise is mainly on the surrounding industrial enterprises have an impact. During the operation of the project, through all the noise sources to take effective measures such as vibration damping, sound insulation, muffling, etc., it has a certain impact on the environmental noise and plant noise, but the impact is relatively small, and it will not change the regional environmental function, the project plant noise can reach the "industrial enterprise plant boundary environmental noise emission standards" (GB12348-2008) Class III standards. In summary, the possibility of the project's impact on the acoustic environment is assessed as "Slight", and the consequence level is categorized as "Minor". Therefore, the overall significance level of these impacts on noise pollution is categorized as "Low".

2) Baseline Comparison

The main purpose of this project is to improve the utilization rate of yellow phosphorus tail gas. Compared with before the implementation of the project, the annual reduction of particulate matter is 60t, and the total annual emission after calculation does not exceed 16t; the annual reduction of sulfur dioxide is 1250t, and the total annual emission after calculation does not exceed 76t; the annual reduction of nitrogen oxides is 153t, and the total annual emission after calculation does not exceed 153t; the emission of other atmospheric pollutants can be reduced and discharged according to the standard, and does not produce new working wastewater.

(7) Summarize

The pollutant emissions and risk levels of each demonstration project are shown in the table below. Overall, PhosChemEE projects are mainly based on transformation and upgrading, focusing on tailings utilization, efficient and clean production, and waste resource utilization, and have better environmental performance. From the viewpoint of the project itself, the environmental risk is mainly focused on sudden environmental accidents in terms of water pollution and soil pollution. Under normal working

conditions, the risk of discharge of conventional pollutants is small.

Table 5-5 Statistics on pollution and waste releases and risk levels for project

Demonstration Site	Air pollution (risk level)	Water pollution (risk level)	Solid waste pollution (risk level)	Soil contamination (risk level)	Noise pollution (risk level)
Guizhou Wengfu (Group) Co., Ltd	Small amount of dust. (low)	Surface and groundwater contamination may result from dam failure of tailings impoundments, rupture of concentrate and backwater transfer lines, and unorganized equipment leakage. (Moderate)	100% solid waste disposal. (Low)	The key area of soil erosion is the tailings pond. A rupture accident in the concentrate slurry transfer pipeline or the return pipeline would have a contaminating effect on the soil along the route. (Moderate)	The project is located in the middle of the existing plant and will have a low impact on the surrounding noise. (Low)
Sichuan Development Tianrui Mining Co., Ltd.	A small amount of residual beneficiation chemicals have low volatility. (Low)	No production wastewater discharge. (Low)	Solid waste is disposed of by concentrate export and does not need to be exported for separate disposal. (Low)	-	The acid mixing preparation station plant is arranged close to the center of the plant, away from the plant boundary and sensitive protection targets. (Low)
Guizhou Kailin Mining and Fertilizer Co., Ltd.	Fluoride concentrations all meet standards (Low)	Under abnormal conditions, continuous leakage of contaminants occurs along the location of the breach where the imperviousness fails Contaminants can have some impact on the surrounding groundwater. (Moderate)	-	Operational accidental spills from the project would have a low impact on the soil environment. (Low)	The daytime and nighttime noise values at the east, south, west and north plant boundaries of the project plant meet the standards. (Low)
Yunnan Phosphate Chemical Group Co., Ltd.	-	-	Solid waste resource utilization and conversion to form a closed-loop production	Phosphorus tailings are used for ecological restoration of the mining area to restore the land. (Low)	-

			model. (Low)		
Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.	This project involves the hazardous substance diesel fuel. If a fire accident occurs in the storage tank area, the associated pollutants carry out the atmospheric environment causing environmental pollution. (Moderate)	No production wastewater is discharged. (Low)	The solid waste disposal rate during the production and operation period of this project is 100%. (Low)	Atmospheric deposition has a low impact on the soil environment. (Low)	There is no sensitive point within 50m around the project, so the noise impact of the project on the surrounding environment is small. (Low)
Zhonglicheng Industrial Co., Ltd.	Normal emission conditions will not result in exceedance of the regional and various sensitive points air quality standards. (Low)	Total phosphorus exceeded under abnormal operating conditions. (Moderate)	After the solid waste generated by this project is disposed of by the disposal measures, the destination is reasonably clear and will not cause secondary pollution. (Low)	The probability of impact on soil is low when the plant area is hardened, cofferdams are installed, and a complete drainage system is laid out. (Low)	There are mainly industrial enterprises within 200m around the project, and there are no residents, schools and other environmentally sensitive protection targets. The noise reaches the standard. (Low)

5.2.3 Climate Change

The six demonstration projects involve efficient utilization of tailings, resource recovery, and technological transformation of the phosphorus chemical industry, with significant greenhouse gas emission reduction effects.

(1) Guizhou Wengfu (Group) Co., Ltd

After applying the whole tail filling mining, in 2022, the actual production of 590,995.16 tons of ore in Datang Mine of Wengfu Phosphorus Mine, 216,402 tons of tailings are filled and utilized, 104,074.4 tons of tailings are consumed more, 7,983.5 tons of cement are reduced, energy consumption is reduced by about 1,929 tons of standard coal, and CO_2 emission is reduced by 5,015 tons per year.

In 2023, it is expected that Wengfu phosphorus mine will fill and utilize 500,000 tons of tailings, and reduce carbon dioxide emissions by 12,856 tons per year. In 2024,

it is expected that the tailings will be filled and utilized by 800,000 tons, and carbon dioxide emissions will be reduced by 20,570 tons per year, which is more than the expected target of reducing carbon emissions by 18,294 tons per year. In 2025, it will be filled and utilized by 1,200,000 tons of tailings, and carbon dioxide emissions will be reduced by 30,856 tons per year. by After 2026, the utilization of 1.5 million tons per year of tailings and the reduction of CO_2 emissions by 38,570 tons per year will be realized. Resource utilization: according to the project implementation content and the actual situation of the mine, it is expected that the ore recovery rate can be increased by 14%-16%, and the utilization of tailings dissipation can be increased to more than 120 tons per year.

Table 5-6 Carbon reduction matrix

Year	Filling volume/million tons	Ways to reduce carbon emissions		Total(t)
		Carbon reduction/t from filling process optimization (fine sand filling optimized to full tail filling)	Optimized carbon reduction in cementitious materials/t (30% reduction in cement use)	
2022	19.5	970	4045	5015
2023	50	2485	10371	12856
2024	80	3976	16594	20570
2025	120	5964	24892	30856
2026	150	7455	31115	38570

(2) Sichuan Development Tianrui Mining Co., Ltd.

Sichuan Development Tianrui Mining Co., Ltd. will optimize the control of the reaction process, including stirring speed and reaction time, to obtain the optimal H_3PO_4/H_2SO_4 ratio. Optimizing the operation of the control system reduces the total consumption of H_2SO_4 and the energy used to produce one ton of phosphate concentrate. Compared to the baseline project, the incremental investment will save an additional 463 tons of energy, while the incremental reduction in greenhouse gas emissions is 1,191 tons of CO_2 per year. In addition, phosphate recovery will be increased from 85% to 90% and phosphate concentrate will be increased by 4.0%.

(3) Guizhou Kailin Mining and Fertilizer Co., Ltd.

The production process of phosphoric acid is mainly divided into two kinds: thermal phosphoric acid and wet phosphoric acid. The traditional thermal process mainly uses yellow phosphorus as raw material, and produces phosphoric acid through the reaction of electric furnace reduction, oxidation, hydration, etc. The purity of

phosphoric acid produced by this process can reach the industrial grade and food grade, but the energy consumption is high and the pollution is big. The purification of wet phosphoric acid production than thermal phosphoric acid production of low energy consumption, pollution, more and more enterprises to adopt the purification of wet phosphoric acid process to replace the thermal process for the production of phosphoric acid, but at the same time, there are low purity of wet phosphoric acid, poor quality and other issues, it is difficult to reach the industrial grade and food grade.

If the final production capacity of this demonstration project is the target for calculation, the annual output of 400,000 tons of thermal phosphoric acid (246,000 tons of P_2O_5), the annual consumption of 414,262.5 tons of standard coal, emissions of 147,037 tons of carbon dioxide equivalent. This project adopts the wet process to produce phosphoric acid, and improves the quality of wet process phosphoric acid through the advanced purification process of desulfurization system, filtration system, concentration system, extraction system, counter-extraction system and fluorine removal system, so as to produce high purity product acid with low energy consumption and low pollution. The advantages of this technology compared with the traditional technology are mainly the following two points: firstly, the wet purification process of phosphoric acid production has low energy consumption, and can ensure that the product acid meets the standard of hot acid; secondly, compared with the raw material of hot phosphoric acid production of yellow phosphorus, the wet phosphoric acid preparation does not have the problem of exhaust gas and yellow phosphorus residue treatment, and waste heat. Therefore, the promotion of wet process phosphoric acid purification process that can produce high quality phosphoric acid is of great significance for the improvement of product quality and the reduction of energy and carbon emissions. This project can realize the wet phosphoric acid purification process to reach 400,000 tons per year capacity, annual consumption of 138,396.7 tons of standard coal, annual carbon dioxide emissions of 459,433 tons of equivalent, annual energy savings of 275,866 tons of standard coal, reducing emissions of more than 1014,604 tons of carbon dioxide equivalent per year, and annual savings of 101,372,000 RMB (156,110,000 U.S. dollars) in energy costs.

In the same production of phosphoric acid (H_3PO_4) content of 85%, the comprehensive energy consumption per unit of product is about 346kgce per ton , which is 690kgce per ton lower than that of phosphoric acid produced by the traditional

thermal process, and the carbon dioxide emission per unit is 1,148kgCO_2 per ton, which is 2,537kgCO_2 per ton less than that of traditional phosphoric acid produced by the thermal process. According to the accounting method provided by GEF, according to the current wastewater delivery of 65m^3 per hour, the P_2O_5 in the wastewater is discounted at 3%, and the specific gravity of the wastewater is 1 (water after filtration), the amount of P_2O_5 lost per hour is about 1.95 tons. According to the design production time of 330 days, the amount of P_2O_5 can be recovered annually is about 15,444 tons (total phosphorus), the actual recovery rate is currently discounted at 60%, the DCP plant recovery according to 95%, then the recovery of P_2O_5 is 8,803.08 tons per year. Energy consumption can be saved equivalent to 4693 tons of standard coal, saving energy costs of 6.63 million RMB; reduce CO_2 emissions of 15,264 tons equivalent per year. According to the discount price of P_2O_5 2,200 RMB per ton, the annual economic benefit of 19.367 million RMB.

Table 5-7 Carbon reduction matrix

Mode	**Quantity (tP_2O_5)**	**Main use**	**quantities**	**unit**	**price of item**	**conversion factor**	**Converted standard coal (tce)**	**Percentage of total consumption (%)**	**Energy costs(RMB)**	**Emissions of CO_2 (tons)**
P_2O_5 Production	8803.08	vapor	49519	t	120	0.0900	4457	89.09	5,940,000 yuan	14355
		electrical power	3626	MWh	0.50	0.1229	446	8.91	1,810,000 yuan	1911
		other					100	2.00	130,000 yuan	322
		total					5002		7,890,000 yuan	16589
P_2O_5 Recovery	8803.08	electrical power	2513	MWh	0.50	0.1229	309		1,260,000 yuan	1325

(4) Yunnan Phosphate Chemical Group Co., Ltd.

The project produces additional phosphate concentrate through an integrated phosphate tailings recycling and reuse facility, enriched substrates for use as a fertilizer substitute, and construction materials made from phosphate tailings. The re-concentration of the phosphate tailings will reduce annual electricity use by 4,369 megawatt-hours while reducing annual carbon dioxide emissions by 3,514 tons. Mineral-rich substrates as a substitute for fertilizers would reduce annual energy consumption by 3,600 tons, or about 11,650 MWh, and annual greenhouse gas emissions by 9,369 tons of carbon dioxide. Phosphate tailings building materials would reduce annual energy consumption by 650 tons, approximately 2,104 MWh, and annual

GHG emissions by 1,692 tons of CO_2. Overall, total annual energy consumption would be reduced by 5,600 tons and total annual GHG emissions would be reduced by 14,575 tons per year.

(5) Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.

The project adopts comprehensive utilization of phosphogypsum technology to produce improved gypsum, replacing calcium carbonate with a polymer composite filler. 1 million tons of phosphorus building gypsum powder reduces CO_2 emissions by 262,000 tons per year compared to the production of natural gypsum powder (including 248,900 tons for the baseline project and 13,100 tons for the incremental activity).

(6) Zhonglicheng Industrial Co., Ltd.

The main objective of the project is to enhance the utilization of yellow phosphorus tail gas. It will reduce CO_2 emissions by 77,598 tons per year (of which 1,022 tons will be reduced by the baseline project and 6,567 tons by incremental GEF inputs), and save 45,095 tce (of which 41,273 tce will be saved by the baseline project and 3,822 tce by incremental GEF inputs).

(7) Summarize

The PhosChemEE projects all have very good GHG emission reduction effects, and the possibility of impacts on climate change is assessed as "Slight", and the consequence level is categorized as "Minor". Therefore, the overall significance level of these impacts on climate change is categorized as "Low", and the PhosChemEE project is exemplary for the reduction of GHG emissions in the whole life cycle of the phosphorus chemical industry from the perspective of the whole PCI chain.

Table 5-8 Carbon dioxide emission statistics

Demonstration Site	Baseline situation CO_2 emissions (tons)	Baseline Project CO_2 emission reduction (tons)	Alternative Project CO_2 emission reduction (tons)	Alternative Projects Incremental emission reduction (tons)
Guizhou Wengfu (Group) Co., Ltd	20208	12139	18294	6155
Sichuan Development Tianrui Mining Co., Ltd.	59493	10479	11670	1191
Guizhou Kailin Mining and Fertilizer Co., Ltd.	445936	297457	317599	20142
Yunnan Phosphate Chemical Group Co., Ltd.	15876	-	14575	-
Yunnan Xiangfeng Environmental	-	248900	262000	13100

Protection Technology Co., Ltd.				
Zhonglicheng Industrial Co., Ltd.	-	71022	77598	6567

5.3 Social Risks

5.3.1 Affected Groups/Communities

All six demonstration projects have carried out environmental impact and safety assessments to ensure that the impact on affected groups or communities is minimized and that appropriate countermeasures are provided. The following is an analysis of the groups or communities affected by each of the six demonstration projects, focusing on the social risks associated with them. The risk of project impact on neighboring communities is relatively low, mainly because these projects are either in industrial parks or out of the mining area, and even if there are groups in the vicinity, they are mostly industrial enterprises, and the residents in the vicinity will move away or migrate to other places in consideration of their impacts. In addition, the industrial park is also surrounded by industrial enterprises, and these enterprises or workers have studied the risks in the park, and will also reduce the impact on them, so the social risk of this part is "Low".

Table 5-9 Impact of the PhosChemEE project on groups or communities

Demonstration Site	Groups or communities affected
Guizhou Wengfu (Group) Co., Ltd	The urnphosphate mine project is mainly located in Datang Town, the administrative division of which belongs to Yuhua Township, urnan County, Fuquan City, Qiannan Buyi and Miao Autonomous Prefecture, Guizhou Province, with a well-developed transportation network.
Sichuan Development Tianrui Mining Co., Ltd.	The project is located in Mabian County (Mabian County), Leshan City, Sichuan Province, now under the jurisdiction of Yanfeng Township. The scope of the mining right of the mine is Block VIII of the Copper Factory Ridge Section of the Laoheba Mining Area of the Mabian Phosphorus Mine, which is some distance away from the urban area.
Guizhou Kailin Mining and Fertilizer Co., Ltd.	Project Location: Dashuigou Industrial Park, Jinzhong Town, Kaiyang County, Guiyang City, Guizhou Province, China.
Yunnan Phosphate Chemical Group Co., Ltd.	The project mainly focuses on the company's mines and installations, for example, the company has constructed four large-scale mines, namely Kunyang Phosphorus Mine, Kunyang Phosphorus Mine No. 2, Jinning Phosphorus Mine, and Jianshan Phosphorus Mine, and the company's business scope is broader, and there is a lack of descriptions of the neighboring groups or communities in the project report, and according to the company's business, the production area is mostly the mines near Dianchi.
Yunnan Xiangfeng Environmental Protection Technology Co.,	The project is located in Anning Industrial Park.

Ltd.	
Zhonglicheng Industrial Co., Ltd.	The project is located in the southeastern end of Panzhihua City, Panzhihua Vanadium and Titanium Hi-Tech Industrial Development Zone, Mardianhe Area, the park is 6km north of Jinjiang Town, Panzhihua City, about 25km away from the center of Panzhihua City, Bingcaogang, the Chengkun Railway passes through the park from the north to the south from the east of the park. The Chengkun Railway passes from the east of the park from north to south, and the Chengkun Expressway passes 1km from the northwest of the park.

5.3.2 Ethnic Minorities

Guizhou, Yunnan and Sichuan are typical areas where ethnic minorities are concentrated. Therefore, the issue of ethnic minorities is also the subject of this assessment. On the whole, although the project did not give the number of ethnic minorities in the impacted areas, the basic distribution of ethnic minorities in the smallest areas of the regions where they are located was obtained (Table 5-10). Six demonstration project areas are likely to be surrounded by ethnic minorities. The research shows that there is no case of disrespecting the traditional culture of ethnic minorities during the project period due to the implementation of the project in the region. Therefore, it is concluded that the six projects do not have risks related to ethnic minorities and have the potential to increase the number of ethnic minorities benefiting from the projects, such as facilitating their access to more training, increasing employment opportunities, and facilitating their integration with the Han Chinese community.

Table 5-10 Impact of the PhosChemEE project on Minorities

Demonstration Site	Basic situation of ethnic minorities in the region
Guizhou Wengfu (Group) Co., Ltd	Fuquan has a total population of 316,700, with a minority population of 85,400, including 25 ethnic groups such as Han, Miao, Buyi, Dong, Yi and Shui.
Sichuan Development Tianrui Mining Co., Ltd.	Mabian County is located on the southwest edge of the Sichuan Basin in the Xiaoliang Mountain area, with a total population of 180,000 people, mainly Han Chinese, about 37% of which are Yi, with a small number of Miao, Hui and Zhuang.
Guizhou Kailin Mining and Fertilizer Co., Ltd.	In Kaiyang County, there are more than twenty ethnic groups, including the Yi and Bai, distributed mainly in the territory.
Yunnan Phosphate Chemical Group Co., Ltd.	The neighborhood of Dianchi in Yunnan is a typical ethnic minority gathering area, mainly consisting of the Yi, Bai, Mongol, Hui, Miao, Hani, Dai and Naxi ethnic groups.
Yunnan Xiangfeng	Longfengqing Village is a Han-dominated natural village with 185 Han, 2 Yi and 4 other ethnic groups.

Environmental Protection Technology Co., Ltd.	
Zhonglicheng Industrial Co., Ltd.	There are 42 ethnic groups in Panzhihua, with Han Chinese accounting for 86.6% of the city's population and the more populous Yi ethnic group accounting for 8.89% of the 41 ethnic minorities, followed by the Lisu and Miao ethnic groups.

5.3.3 Land Tenure System

This project is mainly a renovation project, and the six demonstration projects have complete formalities and clear land ownership, all of which can be used for industrial buildings. The four boundaries of the projects except Yunnan Phosphorization are clear (Table 5-11). Therefore, the evaluation of the land tenure system does not pose a risk to project implementation.

Table 5-11 PhosChemEE project basic information on land tenure or area

Demonstration Site	Project basics
Guizhou Wengfu (Group) Co., Ltd	The mining area of Datang section is 3.312km^2, and the expansion will construct concentrate dewatering facilities and loading systems in the original phosphate fertilizer plant without new land occupation. The implementation of the project can cancel the originally planned Xiaowengguang tailing pond, reducing investment and industrial land.
Sichuan Development Tianrui Mining Co., Ltd.	The scope of mining rights of the mine is the No.8 block of the Copper Factory Ridge section of the Laoheba mining area of Mabian Phosphorus Mine, with an area of 2.99km^2, which is now under the jurisdiction of Yanfeng Township.
Guizhou Kailin Mining and Fertilizer Co., Ltd.	The address of the project is located in the vacant land reserved for fine phosphorus chemical industry planning in Dashuigou Industrial Park, Jinzhong Town, Kaiyang County, and the total land area of the construction project is 73,512 m² (110.3 acres), of which the newly built part of the enclosure covers 64,909 m² (97.4 acres), and the utilized part of the land area is 8,603 m² (12.9 acres). The project does not add new land, the original land type is industrial land, and the construction of the project will not change the regional land use function.
Yunnan Phosphate Chemical Group Co., Ltd.	There is no specific definition of the radius and area, and the project is implemented in the existing plant area.
Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.	The plant site was built in Longfengqing Village, Willow Village Committee, Caopu Street Office, Anning City, Yunnan Province. The reclaimed area of the Songping Longshu Phosphate Mine is used as a production area for the comprehensive utilization of phosphogypsum, and the newly requisitioned land to the south-east of the site is used as a turnaround site for phosphogypsum, which is the main raw material, and there is no new land.
Zhonglicheng Industrial Co., Ltd.	The project area is 63.59 mu, the specific address for the Sichuan Panzhihua Vanadium and Titanium Hi-tech Industrial Development Zone, Mardianhe Area, in the enterprise's existing plant construction, project construction in line with the industrial positioning of the park and environmental access conditions, in line with the park planning.

5.3.4 Physical Resettlement

Physical Resettlement mainly refers to two aspects, respectively, the project completion should be supporting facilities for enterprises, mostly self-configuration, and the expansion of the need to increase the production units as well as public and auxiliary facilities. According to the following Table 5-12, which is part of the six demonstration projects, enterprises are responsible for the technical transformation supporting the corresponding physical resettlement situation. The assessed risk is "Low".

Table 5-12 PhosChemEE project physical resettlement

Demonstration Site	physical resettlement problem response situation
Guizhou Wengfu (Group) Co., Ltd	The original office building was dismantled and used for the powder ore silo of the new concentrator; the original lime milk preparation room was dismantled and transformed for utilization; the original maintenance room was dismantled and used for the installation of concentrate thickener, tailings re-selection thickener and lime milk storage tanks of the new concentrator; the original boiler room and bathroom were dismantled and used for the new office building. The water generated from tailings filtration is used to rinse the filter cloth after precipitation in the sedimentation tank, and is recycled; rainwater and sewage diversion ditches and production water collection tanks are built in the industrial site, and the same recycling process is carried out after precipitation; water filtration valves are installed at the bottom of the underground mining area, and at the same time, water filtration collection tanks are constructed at the bottom of the mining area at the position of the filling retaining wall, so as to carry out the preliminary treatment of filling filtration water downhole, and then the processed filling filtration water flows freely to the environmental protection station through the drainage ditch downhill, for treatment. After treatment, the filtered water will flow to the environmental protection station, and then be used for production recycling or discharged according to the standard.
Sichuan Development Tianrui Mining Co., Ltd.	Supporting the design and construction of civil concrete devices, phosphate concentrate cyclone classification system (classification of low-quality phosphate concentrate), raw material storage buffer mixing system, concentrate slurry conveying system, reaction device, sulfuric acid conveying system, automatic water replenishment system, mixing and acid conveying system automatic slurry adjusting system, temperature control system, acid mist treatment system, power supply system, intelligent control system (intelligent control design panel), safety and protection systems and so on.
Guizhou Kailin Mining and Fertilizer Co., Ltd.	Plant construction including pretreatment, extraction, reprocessing, general plan, utilities, plant power supply and distribution, plant water supply and drainage, inner pipe and inner pipe corridor, plant communication, control room, air and nitrogen stations, foam fire fighting station, tank area, dumping ground, etc.
Yunnan Phosphate Chemical Group Co., Ltd.	Intelligent mining and green sorting of phosphorus ore, phosphorus chemical industry and phosphorus-based new materials, solid waste resource utilization and ecological restoration, green intelligent fertilizers and plateau specialties of agriculture as the key direction of attack, to carry out the use of phosphorus resources throughout the industrial chain of core technology research and industrialization and promotion.
Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.	Layout of production auxiliary facilities and public works area to ensure reasonable. Supporting water supply and drainage design, design content mainly includes the whole plant supporting the design of the water supply and drainage pipe network.
Zhonglicheng	Installation of yellow phosphorus tail gas cabinet and corresponding DCS

Industrial Co., Ltd.	instrumentation control system.

5.3.5 Economic Displacement and Access Restriction

The project involves a small number of immigrants. The project residents relocation and resettlement of project residents under the unified planning and leadership of the local government can be resettled in a unified planning area with convenient transportation and relatively complete living service facilities, which can meet the basic requirements of migrants in life. In addition, the construction unit should give priority to migrant households to solve the employment problem. Overall, it seems that through the economic compensation and employment compensation, etc., can alleviate the impact on the residents, and the way of relocation, so that the residents are far away from the project site, reducing the risk of environmental pollution. At the same time, the impact on the quality of life of the relocated households is not significant, and the migration will not cause major changes in the local population, with little impact on the living environment of the local residents. Not every one of the six demonstration projects has adopted compensation for economic displacement, and only a few of the demonstration projects have expressed the relevant situation. According to the Panzhihua vanadium and titanium high-tech industrial development zone (vanadium and titanium new city) vanadium and titanium new city construction bureau issued "about, at present, the enterprise whole plant health protection distance (1km) within the village involved in the Yutang village on the must preserved villagers group housing a total of 20 households, relocation and resettlement work by vanadium and titanium high and new technology zone management committee is responsible for organizing the implementation of resettlement, resettlement mode for the farm to non-farming resettlement, has been incorporated into the relocation in 2017 Resettlement program, and has been in the Ajilu resettlement area allocation of resettlement housing and completed the resettlement work (relocation funds have been implemented), relocation funds from the management committee of self-funding. The houses within the sanitary protection distance have not been dismantled because the villagers need to use them temporarily to take care of the fruit trees. In summary, the possibility of the impacts of the relocation and resettlement of the project on the lives of the local residents is assessed as "Slight", and the level of consequences is categorized as "Minor". Therefore, the overall significance level of these impacts on the lives of residents is categorized as

"Low". Since most of these businesses are located in industrial parks, local residents do not have as easy access to the industrial parks, which also reduces the risk of residents being affected by them.

5.3.6 Livelihoods

The construction of this project can make a great contribution to the realization of green and low-carbon mining and comprehensive utilization of resources, eliminating the current state of waste of resources and insufficient environmental protection performance, as well as making a great contribution to the local economic development and the construction of green mines. At the same time, the project will create a certain number of jobs, which is conducive to alleviating local livelihood problems. The following is the income situationsix projects.We. W can see that the increase in enterprise output value is conducive to the increase of tax revenue, which brings sufficient tax sources to the local area and can feed the local economic development. At the same time, the projects also increase jobs, improve enterprise efficiency, and ultimately increase the livelihood of employees.

Table 5-13 Impact of the PhosChemEE project on livelihoods

Demonstration Site	Impact on livelihoods
Guizhou Wengfu (Group) Co., Ltd	Economic benefits: the incremental investment cost of the demonstration project is US$800,000. After the implementation of the demonstration project, for example, at the Datang Mine, the annual electricity cost is US$446,923, the cost of cementitious materials is US$165,000, and the total cost is US$209,692,300 per year, with an incremental cost saving of US$387,999 per year, a payback period of 2.1 years, and the project's net present value (NPV) of 233,323,325 The payback period is 2.1 years and the NPV of the project is 233,425 USD, with an internal rate of return (IRR) of 48.4% over the life of the project. Social benefits: the implementation of the project will eliminate the Xiaowengguang tailings pond, reduce investment and industrial land, and the high-intensity laborers who plan to work at the Xiaowengguang tailings pond will be able to adjust to lighter operating positions at the full tailings filling station.
Sichuan Development Tianrui Mining Co., Ltd.	The implementation of the project is expected to complete the fine debugging and stable operation for the enterprise to reduce the production cost of 9.8 million yuan per year; the acid consumption of the plant to reduce the acid consumption by about 15-20%, the annual savings of acid consumption costs of 2.7 million RMB, an increase of phosphorus recycling profits generated by 2.25 million RMB, an average increase in profits and taxes of 4.95 million RMB, the project's economic benefits are significant. The net present value of the project is positive, and the pre-tax payback period is 5.7 years.
Guizhou Kailin Mining and Fertilizer Co., Ltd.	More than 90,000 tons of concentrate are recovered each year, with an economic benefit of more than 20 million RMB per year. The resource utilization of phosphorus tailings can gradually and completely eliminate the safety hazards brought by tailing ponds. Phosphorus tailings are used for ecological restoration of the mining area, which restores the surrounding ecological environment and achieves the purpose of integrating into the ecosystem and restoring the land. The resource utilization of phosphorus tailings can exceed 500,000 tons per year, and the ecological restoration has led to the employment of 50 migrant workers in the

	surrounding area; for the phosphorus tailings-based agricultural green fertilizers, it has led to the employment of more than 200 people; for the phosphorus tailings emission reduction technology and obtaining high-quality phosphorus concentrate products, the number of related employment is more than 100 people; for the phosphorus tailings-based solidification material products and technology, the number of related employees reaches 50 people. The cumulative number of employees are driven by more than 400 people.
Yunnan Phosphate Chemical Group Co., Ltd.	The project's average annual operating income is estimated to be $248.75 million (including taxes).
Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.	This project adds 160 production workers; it can save energy consumption equivalent to 4,693 tons of standard coal, saving energy costs of 6.63 million RMB; it reduces CO_2 emissions by 15,264 tons of equivalent per year. According to the discounted price of P_2O_5 2,200 RMB per ton, the annual economic benefits of 19,367,000 RMB.
Zhonglicheng Industrial Co., Ltd.	The environmental protection measures taken by the company can achieve good governance results, well protect the surrounding environment, and achieve greater environmental benefits with less environmental protection investment, its environmental benefits, environmental and economic gains and social benefits are significant.

5.3.7 Cultural Heritage

The area where the project is located is mainly an industrial park or a general mining area, and does not involve important cultural monuments, historical sites or scenic spots. Therefore, the likelihood of impacts on cultural heritage is assessed as "Slight" and the level of consequence is categorized as "Minor". Therefore, the overall significance level of these impacts on cultural heritage is categorized as "Low".

5.3.8 Gender Discrimination

The construction documents of the demonstration project mention that the renovated project is suitable for more female workers; female and male workers enjoy the same treatment, which strongly promotes the sustainable development of gender equality; female employees can become the main manipulators of their positions and realize their personal value after being trained; and the improved working environment is more conducive to women's health and employment. Although some of the demonstration projects did not specifically discuss and evaluate women's participation, women's participation is also very important. Women are an important force in the surrounding communities. For example, Longfengqing Village has 58 farming households and a total village population of 191, of which 98 are men and 93 are women. This shows that the ratio of women to men in the surrounding community is about 1:1, which cannot be ignored. None of the other projects give more information on female recruitment, wages, tenure, etc. in this regard, so it is not easy to make a

precise judgment on gender discrimination here. However, in China, there is a high degree of similarity in the employment situation in the same region and industry, and and there is no gender-specific or male-oriented information in the recruitment related to it. Therefore, from the available information, the programs do not discriminate on the basis of gender. Of course, this judgment needs to be determined by further research.

5.3.9 Community Health and Safety

The community health and safety issues involved in this project mainly include environmental pollution and disaster accident risks. The flammable and explosive, toxic and hazardous substances of the chemicals involved in the operation of the project are mainly: yellow phosphorus tail gas stored in the tail gas cabinet, yellow phosphorus tail gas is a mixture of gases, and its main hazardous gas is CO, and it also contains HF, CS_2, H_2S, P_2O_5, CH_4, etc., which are the toxic substances listed in Appendix B of the Technical Guidelines for Evaluation of Environmental Risks of Construction Projects (HJ 169-2018). In case of leakage of these substances, it is likely to cause fire and explosion accidents, and in the event of fire and explosion accidents, the associated/secondary pollutants generated will pollute the regional environment, which will have an impact on the health and safety of the community.

For phosphorite-related projects, it is necessary to conduct safety risk evaluations, and for these six demonstration projects, safety risk identification evaluations have been completed, especially for major safety hazards, that could potentially pose significant risks to the community (Table 5-14). Some of the evaluations have also given solutions at the same time, and giving appropriate publicity, education, and drills to the community is an important measure to reduce risks. With proper implementation, risks can be effectively reduced. However, since only two of the six demonstration projects have provided complete safety evaluation reports, and the others are about to be completed or partially completed, the risk to the safety and health of neighboring communities (including industrial parks) is considered to be moderate.

Table 5-14 Status of safety evaluation in the PhosChemEE project

Demonstration Site	Status of safety evaluation
Guizhou Wengfu (Group) Co., Ltd	The project basically meets the requirements of relevant national laws, regulations and technical standards from the point of view of safety production.
Sichuan Development Tianrui Mining	Security risk evaluations will be conducted, targeting the construction, installation, commissioning and operational phases of risk assessment.

Co., Ltd.	
Guizhou Kailin Mining and Fertilizer Co., Ltd.	Lack of identification of significant security risks and failure to consider impacts on neighboring communities, etc.
Yunnan Phosphate Chemical Group Co., Ltd.	Assessments for occupational safety and health, fire protection, lack of identification of significant safety risks, and no consideration of impacts on neighboring communities, etc.
Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.	Identify safety hazards, complete safety and health assessments, give countermeasures, and lack of impact analysis on the surrounding community.
Zhonglicheng Industrial Co., Ltd.	With a complete safety evaluation report, identifying the major risk factors, focusing on the enterprise and its impact on the surrounding area, the project's safety evaluation meets the requirements of the relevant national norms in force, and the project is feasible from the safety point of view.

6 Analysis of Alternatives

6.1 'No Project' Alternative

The purpose of the alternative analysis is to identify other options that can be used to achieve project objectives and compare their impact on the current implementation plan. There are two basic alternative options for this project: one is "no implementation of the project," and the other is "implementing the project as usual." Given the urgent need of local governments to develop the economy, the option of "not implementing the project" is not feasible. Nevertheless, the principle of prioritizing environmental and social benefits was adhered to during the implementation of the project, and six of the ten alternative demonstrations were selected for demonstrations.

6.2 'Business As Usual' Alternative

The alternative option for implementing the project is to proceed with the existing, widely adopted technology. The actual implementation plan for the project is based on the alternative option of proceeding with the project as usual, with continuous optimization resulting from it, reflecting the additional value of this project. The following provides a brief analysis of the alternative option for implementing the project as usual for six demonstration projects.

6.2.1 Application of Full Tailings Filling Technology in Underground Phosphate Mines

Guizhou Province is the second largest phosphate ore reserve in China. The

properties of Guizhou ' s phosphate rock resources have led to a large underground mining activity in the region. In underground ore phosphate mining, Guizhou Wengfu Phosphate Mine utilizes the tailings-mixed-with-sand-and-gravel filling technology, in which phosphate tailings are mixed with sand, gravel and other cementing materials (mainly cement) and the mixture is used as filler into the underground goaf. After it has been treated and consolidated, the mixture reaches the required strength to support the goaf. Compared to the room and pillar mining method, this technology can increase the resource utilization rate by about 20%.

In this method, due to the fine particle size of phosphorus tailings, sand and gravel need to be added as aggregating agents to increase the strength of the filler. Depending on the particle size of phosphate tailings, the amount of sand and gravel added ranges from 17% to 23% by weight. The addition of sand and gravel limits the use of phosphate tailings, and at the same time, the transportation and crushing of sand and gravel also consume energy and emits GHG. Therefore, there is a need to find a filling technology with lower carbon emissions. This can be achieved by increasing the use of phosphate tailings and reduce the high energy consuming sand and gravel.

The project demonstration site Guizhou Wengfu Company, located in Fuquan City, Guizhou Province, has a mining capacity of 7.5 million tons per year. and a tailing production of 2.8 million tons per year. In Business as usual scenario, in the mining process, about 20%-30% of the empty volume left after the phosphate ore has been extracted needs to be filled to support the mine, in addition to the pillars. At present, Guizhou Wengfu Phosphate Mine uses a total of 800,000 tons of tailings and 400,000 tons of sand and gravel per year; the percentage of tailings, sand and gravel mixture in the filler is about 70%, while the balance are cementing materials. The sand and gravel required is obtained from rock that is crushed and graded, and the crushing process has high energy consumption, resulting in high filling costs. The crushing process will also cause dust and noise pollution. The energy consumption of the mine includes: (a) diesel consumed for sand and gravel transportation; (b) electricity consumed for crushing and classification of sand and gravel; and (c) electricity consumed for tailings dewatering. All the electricity required by the mine is supplied by the grid. The total energy consumption is 10,046 tce, and the GHG emission is 20,208 tCO_2.

Compared to the BAU, through the implementation of the project, 8,250 tce will be replaced a year, thus reducing CO_2 emissions by 18,294 tons per year. In addition, the

amount of tailings used can be increased from 800,000 ton per year to 1.2 million tons per year.

6.2.2 Intelligent Device and Application of Mixed Acid Preparation for Phosphorus Float Selection

With 800 million tons of proven reserves, Mabian County, Sichuan Province has abundant phosphate resources. The average grade is low to medium, between 21% P_2O_5 and 24% P_2O_5. Because of this, the mined ore must be processed and concentrated before used as a subsequent chemical raw material. Therefore, the optimization and application energy efficient ore concentration process technologies have a great impact in carbon emissions reduction for the phosphate ore mining industry in Sichuan Province.

The demonstration site, Sichuan Development Tianrui Mining Co., Ltd., is located in Mabian County, Sichuan Province. The mining capacity of this demo company is 2.5 million tons per year., and the production capacity of its phosphate concentration plant is 2.0 million tons per year.

Business as usual scenario: in the ore concentration stage, the conventional flotation operation requires the addition of a large amount of sulfuric acid as flotation depressant, up to 70,000 tons per year. On the other hand, phosphoric acid is an optimal depressant for phosphate rock flotation, but there is no phosphoric acid producer in Mabian County and purchasing phosphoric acid will have high costs, and long transport distances will require additional energy consumption. Data provided by the demo company show that 20.4 kg of diesel are required to transport one ton of sulfuric acid by trucks from HanYuan to Mabian County. The total amount of diesel needed is 1,428 tons per year., while the electricity used in the process including grinding, flotation and dewatering is 48.9 kWh for producing one ton concentrate. Since the plant operates at 70% capacity, annually 1.4 million tons concentrate are produced in the 2.0 million tons raw ore per year. plant, the total electricity consumption is 68,460 MWh per year. The total energy consumption is 23,239 tce, while the GHG emissions are 59,493 tCO_2.

Compared to the BAU, the incremental investment will produce additional annual energy savings of 463 tce, while the incremental annual GHG emissions reductions are 1,191 tons CO_2. In addition, the phosphate ore recovery rate will increase from 85% to 90%, and the volume of the phosphate concentrate will increase by 4.0%.

6.2.3 Application of Advanced Purification Technology to Produce High-purity Wet Purification of Phosphoric Acid

There are two main methods to produce phosphoric acid, namely: thermal process and wet process. For the conventional thermal process, yellow phosphorus is mainly used as raw material, and the quality of phosphoric acid produced can reach industrial- and food-grade through reduction, oxidation and hydration steps. However, this process would require high energy consumption and cause pollution. Therefore, the thermal process has been gradually eliminated in developed western countries. Compared with the production of thermal-process phosphoric acid (TPA), the production of purified wet-process phosphoric acid (WPA) has lower energy consumption and less pollution. But the conventional WPA has several problems, especially the low purity and poor quality of the phosphoric acid, which does not achieve industrial and food grades. Thus, it is of great significance to promote a WPA purification technology that can produce high-quality phosphoric acid, in addition to the reduction of energy consumption and CO_2 emissions.

This demonstration is to be carried out by Guizhou Kailin Mining and Fertilizer Co., Ltd., a subsidiary of Guizhou Phosphate Chemical (Group) Co., Ltd. The demonstration is located in Dashi Industrial Park, Jinzhong Town, Kaiyang County, Guiyang City, Guizhou Province. In this demo, starting from the production of WPA, an advanced purification technology is adopted. Thereby, the quality of the purified phosphoric acid (PPA) produced can meet the same standards of TPA, which can be used for high-level products in the industrial and food sectors, and concomitantly realize the goal of lowering energy consumption and reducing pollution . The demo facility has a production capacity of 100,000 tons per year of phosphoric acid.

Business as usual scenario: At present, the production of TPA requires high energy consumption and causes significant pollution. At an annual output of 100,000 tons of phosphoric acid (or 61,500 tons of P_2O_5), the thermal process consumes 186,981 tons of standard coal and emits 445,936 tons of CO_2 per year. Through the implementation of the demonstration, 317,600 tCO_2 emissions will be reduced annually. The total energy consumption will be reduced by 151,366 tce per year.

6.2.4 Multipurpose Large-scale Processing and Utilization of Phosphate Chemical

Wastes

Yunnan Province is one of the main producing areas of phosphate ore in China, featuring large amount of reserves, low grade phosphate ore, and high output of tailings. The demonstration host, Yunnan Phosphate Chemical Group Co., Ltd., is the largest phosphate ore producer in Yunnan Province, with a raw ore production capacity of 11.5 million tons per year. In 2018, it produced about 1.0 million tons of tailings.

Business as usual (BAU) scenario: The only existing waste management method is to stockpile the tailings in ponds, which poses potential risks to the environment such as land degradation, soil and water pollution and ecosystem devastation.

Compared to the BAU scenario, the production of 90,000 tons per year. of phosphate concentrate product from phosphate tailings will save an annual energy consumption of 1,350 tce per year., approximately 4,369 MWh per year., and GHG emissions avoidance of approximately 3,514 tons CO_2 per year. The production of mineral-rich substrate at a rate of 400,000 tons per year. for use as fertilizer substitute will bring about (compared to the BAU scenario) reduced annual energy consumption of about 3,600 tce, approximately 11,650 MWh, and reduced annual GHG emissions of about 9,369 tCO_2. The utilization of phosphate tailings for producing 100,000 tons per year. of building materials will bring about (compared to the BAU scenario) reduced annual energy consumption of about 650 tce, approximately 2,104 MWh, and reduced GHG emissions of about 1,692 tons CO_2 per year. Overall, the investment will bring about a total annual energy savings of 5,600 tce per year, equivalent to 18,123 MWh, and reduced total annual GHG emissions of 14,575 tons CO_2.

6.2.5 Phosphogypsum Production of Composite Fillers Project

Currently, the stock of accumulated phosphogypsum pile in China exceeds 800 million tons, with about 85 million tons added every year. The comprehensive utilization rate is less than 40%, and the stockpile continues to grow. Anning is the main phosphate industry base in Yunnan province, where about 6.2 million tons of phosphogypsum are produced per year in phosphate fertilizer production. The phosphogypsum by-product mainly managed by stockpiling. The stockpile has reached 70 million tons, but the utilization rate of phosphogypsum in Anning is less than 15%. The main reason is that the phosphate has many impurities, leading to poor phosphogypsum quality, which makes its utilization very difficult. On the one hand,

disposed phosphogypsum not only occupies a large land area, but the soluble phosphorus, heavy metals and fluoride contained in it can easily leak with rain and wind erosion, leading to major safety and environmental risks, which has become a bottleneck restricting the sustainable development of the phosphorus chemical industry. On the other hand, the phosphogypsum has high water content and high impurities content. Hence, in order to be utilized widely, phosphogypsum needs to be first pretreated with dehydration and impurities removal, which implies high pretreatment costs in addition to high transportation costs.

The demo project is to be carried out by Yunnan Xiangfeng Industrial Group Co., Ltd. and is located in Caopu Industrial Park, Anning City, Yunnan Province. The group focuses on the production and sales of chemical fertilizer and currently has an annual production capacity of 2.65 million tons of chemical fertilizers and 215,000 tons of chemical products. The annual production of phosphogypsum has reached 3.0 million tons, and the accumulated stockpile has grown to as much as 20 million tons.

Business as usual (BAU) scenario: The company currently produces 3.0 million tons of phosphogypsum per year. About 2.0 million tons of phosphogypsum are effectively treated, while the remaining 1.0 million tons are left for stockpile, at a cost of USD 6.20 per ton. Phosphogypsum has high water content, high impurities and cannot be directly utilized. Phosphogypsum products are still largely used as building materials such as cement retarder, non-fired brick and plastering mortar. These products have low value and a small market, so it is difficult to attract capital investments.

Compared to the BAU scenario, The project's expected results include: (a) 1.0 million tons of phosphogypsum per year utilized for the production of other value added materials (b) reduction of 262,000 tons of CO_2 emissions per year.

6.2.6 Recovery and Utilization of Yellow Phosphorus Tail Gas for Power Generation Project

Currently, yellow phosphorus tail gas [Typical yellow phosphorous tail gas composition: 87-92% CO; 1-8% H_2; 2-5% N_2; 1-4% CO_2, 0-5% H_2O; 0-1% O_2 and traces of other gases. Ma H. and Feng X, 2017, "Contrast Analysis of Recycling and Utilization Approaches of Yellow Phosphorous Tail Gas", Chemical Engineering Transactions, 61, 451-456.] produced by the PCI companies is burned and the flue gas is vented directly into the atmosphere, with no or very minimum heat recovery. The

vented hot combustion gases not only represent a wasted energy source but also pollutes the environment. Zhonglicheng Industry Co., Ltd., the selected demo company, will demonstrate the recovery of yellow phosphorus tail gas and its use for power generation. The demo project will be carried out in Panzhihua Vanadium Titanium High-tech Industrial Development Zone, Panzhihua City, Sichuan Province.

Business as usual (BAU) scenario: The normal production capacity of yellow phosphorus of the enterprise is 60,000 tons per year, and the annual by-product yellow phosphorus tail gas is about 216,000,000 m^3. The enterprise only recovers the energy from less than 30% of the yellow phosphorus tail gas, while over 70% is burned in a flare pit and the flue gas is directly vented.

Compared to the BAU scenario, through the implementation of the demo, 77,598 tons of CO_2 emissions will be reduced annually and energy savings of 45,0956 tce. With the electricity price at USD 0.068 per kWh, the incremental investment can bring about cost savings of USD 844,859 per year.

7. Mitigation and Management Measures

7.1 Environmental Mitigation and Management Measures

7.1.1 Reduce the impact of engineering construction on biodiversity/natural habitat protection

The risk of threats to biodiversity/natural habitat protection is primarily concentrated in the upstream phosphate mining development stage, especially the potential risks caused by the tailings transport pipeline of the Guizhou Wengfu (Group) Co., Ltd. demonstration project. The natural vegetation in the area along the tailings transport pipeline of the project mainly consists of white oak, cypress, and laurel, while the agricultural vegetation mainly consists of rice and rapeseed. During the tailings filtration and dewatering process, if the water input exceeds the pipeline's own capacity, there may be a risk of production water overflow. If the transport pipeline bursts, it will cause damage to the shrub and tree vegetation along the pipeline, soil pollution within the affected area will damage the vegetation in the forestland, and ultimately affect the ecological environment along the pipeline.

To reduce the threat to biodiversity/natural habitat protection caused by engineering construction issues, the focus should be on risk avoidance and risk screening. First, the quality of the transport pipeline project should be improved, and

accident channels should be set up at both ends of the water bodies crossed by the pipeline. An accident pool should be set up at the end of the accident channel to prevent ecological damage. Second, management system construction should be accelerated, and tailings pond management should be strengthened to reasonably control the flow rate of the transport pipeline. Third, install filter valves at the bottom of the underground void area, and at the same time, build a filter water collection pool at the location of the retaining wall for filling the void area. The filling filter water is initially treated underground, and then the treated filling filter water is discharged through the underground drainage ditch to the environmental protection station for further treatment and used for production circulation or discharged in compliance with standards, thus reducing the pollution of the transportation pipeline. Fourth, regularly take samples and test the water quality of the springs located in the mining area and the pipeline route, and analyze the water quality situation. If the water quality changes, further investigate the source and take measures to deal with it.

Table 7-1 Biodiversity/Natural Habitat Protection Measures

Risks and Issues	Mitigation measures	Monitoring (indicators or reports)	Implementation Department
The open-pit mining of phosphate mines upstream may have an impact on the protection of biodiversity/natural habitats in the construction area or along the pipeline route	Strict construction standards for projects involving relevant ecological areas.	Regularly inspect relevant facilities construction and operation	Demonstration Project Enterprises
	Accident channels are set across the water bodies along the route, and an accident pool is located at the end of the accident channel.		
	A filter valve is installed at the bottom of the underground void to reduce the pollutants in the conveyance pipes		
	Strengthen the dispatch management of tailings dams and reasonably control the flow rate of conveyance pipelines	Monitor and review the operation logs and scheduling records of tailings dam dewatering; repair, inspection, and pressure monitoring records of conveyance	Demonstration Project Enterprises

		pipelines	
	Monitor water quality in the designated area	Regular water sampling is conducted at springs and along the pipeline route in the mining area to monitor water quality. All complaints and violations related to construction issues should be reported through the proper channels	Demonstration Project Enterprises, Local Government Department

7.1.2 Development of Environmental Pollution Control Measures

The demonstration project may generate certain construction waste and pollutants during the construction and operation periods, which will have a certain impact on the ecological environment of the project area. For example, the main environmental problems during the construction period do not include noise, dust, construction waste, domestic sewage, etc., generated by foundation excavation as well as equipment installation, and the operation period will have certain impacts on the atmosphere, surface and groundwater, soil, etc. Particularly for the phosphogypsum treatment reuse and demonstration project, if fluorine and arsenic contained in phosphogypsum are released into the atmosphere and soil environment, it will adversely affect surface water/groundwater flora and fauna and pose health risks to the local community.

Therefore, the construction of the demonstration project needs to be based on the actual situation, and special mitigation measures need to be formulated in terms of air pollution, water pollution, soil pollution, noise pollution, etc., to mitigate the impacts of environmental pollution. The demonstration project should set up an enterprise-level environmental management organization, select a full-time staff responsible for enterprise environmental protection management as well as environmental monitoring, and formulate and supervise the implementation of the project's environmental protection planning and management rules and regulations in accordance with China's environmental protection related regulations and standards. At the same time, it should formulate the enterprise implementation plan according to the environmental protection requirements (e.g. total amount control index, standard discharge index, etc.) put

forward by the local government and environmental protection department of the region where the project is located; do a good job of controlling the pollution of the project, and ensure that the environmental protection facilities operate normally. In addition, the Demonstration Project Enterprises (DPE) should be urged to establish pollution source files, regular statistics on the project's pollutant generation and emissions, pollution prevention and comprehensive utilization, and regular reports to the local environmental protection administration and management departments.

Table 7-2 Environmental pollution control measures

Risks and Issues	**Mitigation Measure**	**Monitoring (indicators or reporting)**	**Implementing Department**
Demonstration projects can generate pollution and waste emissions, which may have an impact on the ecological environment	Formulate enterprise-level environmental protection planning and management rules and regulations in accordance with relevant national environmental protection regulations and standards	Status of development of relevant reports	Demonstration Project Enterprises
	Regularly monitor and inspect the project's pollutant generation and discharge situation, pollution prevention and control, and comprehensive utilization	Emission control targets environmental pollutants such as air, water, soil and noise, etc., which are required to be assessed by the local government	

7.1.3 Increased Efficiency in the Utilization of Energy Resources

The PhosChemEE project involves the application of green, low-carbon and energy-saving technologies for the entire phosphorus chemical industry chain in its design and implementation. The production of phosphorus chemical products as well as the processing of phosphogypsum requires the consumption of large amounts of water resources. At the same time, the low efficiency of energy use under the existing process generates a large loss of raw materials and resources and produces wastewater. Although the demonstration project has optimized and adjusted the technological process, phosphogypsum processing may increase water consumption, further leading to more groundwater or surface water extraction and use.

Therefore, DPEs need to focus on improving energy resource efficiency and

maximizing savings in resource use. Specific measures include:

(1) Focus on optimizing the energy consumption structure. Actively guide the DPEs to utilize photovoltaic, hydropower, wind power and other renewable energy sources in their plants and implement "electricity instead of coal" and "electricity instead of firewood" in the fields of phosphorus mining, phosphorus chemical production and transportation.

(2) Implementing the strictest water resource management for DPEs, especially wastewater management and reuse. Strictly implement the water resources demonstration system for construction projects and strictly manage the approval of water withdrawal permits. Based on relevant experiences at home and abroad, promote highly efficient water-saving technologies and products in the DPEs and push forward water-saving renovation of the enterprises.

(3) Promote the economical and intensive utilization of raw materials. Strengthen the management of raw material consumption of DPEs, optimize process technology and improve the accounting system of raw material consumption. Promote "green manufacturing" in the phosphorus chemical production and related equipment and facilities, promote the application of high-strength, high-performance materials, and reduce the types of materials used in manufacturing products.

(4) DPEs should establish a resource efficiency monitoring mechanism. Including the use and its data to measure the relative level of efficiency changes, and regularly report on the project water and energy consumption.

Table 7-3 Measures to improve efficiency in the use of energy resources

Risks and issues	Mitigation measure	Monitoring (indicators or reporting)	Implementing department
The consumption of large amounts of energy resources may exacerbate climate change	Optimize the energy consumption structure of enterprises in demonstration projects and strengthen energy-saving management	Proportion of renewable energy consumption (%); enterprise energy-saving renovation or energy-efficiency improvement programs.	Demonstration Project Enterprises
	Strengthening water resources management	Whether water resource demonstration reports are carried out in accordance with local government requirements.	
	Strengthening the management of raw material consumption	Whether the enterprise is included in the list of national and provincial green manufacturing system.	

7.1.4 Reducing the Level of Greenhouse Gas Emissions

While the implementation of the PhosChemEE project reduces GHG emissions by upgrading phosphorus mining and refining technologies, improving energy efficiency in the production of phosphorus chemical products, and reducing energy consumption, it will also result in direct or indirect emissions of GHGs as a result of the use of the new technologies adding additional energy consumption.

In order to reduce the potential impacts of GHG emissions, the demonstration project will use three options to address this:

(1) The demonstration project will actively promote advanced energy-saving technologies to directly reduce the level of emissions in phosphate ore processing and phosphorus chemical production through technology application.

(2) The demonstration site of the project is located in an area rich in renewable energy resources, such as Yunnan, Guizhou, and Sichuan, and further reduces additional greenhouse gas emissions due to excessive energy consumption through the use of renewable energy in production.

(3) The demonstration project needs to follow the concept of circular economy to avoid waste emissions, promote waste recycling and reuse, and reduce indirect emissions from intermediate material production and waste management.

In addition, the project will continuously track and monitor the level of GHG emissions from the demonstration project and implement GHG emission minimization strategies in accordance with the provisions of the United Nations Framework Convention on Climate Change (UNFCCC).

Table 7-4 Measures to reduce the level of greenhouse gas emissions

Risks and issues	Mitigation measure	Monitoring (indicators or reporting)	Implementing department
Direct or indirect emissions of greenhouse gases resulting from the use of new technologies	Promote advanced energy-saving technologies and directly reduce the level of emissions in phosphate ore processing and phosphorus chemical production through technological applications.	Enterprise Energy Conservation Assessment Report	Demonstration Project Enterprises, local government authorities
	Increased use of renewable energy	Proportion of renewable energy consumption (%)	

	Enhancing waste management and reuse	-	

7.2 Social Mitigation and Management Measures

7.2.1 Improvement of the Standard of Living of the Local Population

The PhosChemEE project carries out demonstration activities in the less developed regions of western China, such as Yunnan, Guizhou, and Sichuan, where one of the project implementation objectives is to enhance the economic and social well-being of local community residents. During project design, project construction consulting activities will be carried out in the selected areas of the demonstration project. The project will provide employment opportunities and reduce poverty in local communities through the potential application of phosphate processing technologies, green upgrading of the existing phosphorus chemical industry, and the creation of new industries through integrated processing and utilization of phosphogypsum. The reduction of phosphogypsum production in these areas will also further minimize the negative impacts of phosphogypsum-related pollutants on local water and soil quality, contributing directly and indirectly to local agricultural production, ecological improvement and public health and safety.

The project shall actively attract local capable and qualified local personnel to work in the enterprise and provide suitable employment positions. In terms of vocational training, the project shall provide relevant skills training for employees, such as training on the operation and management of phosphogypsum turnaround yards, training on safety and education, and language training, etc., so as to ensure that the local employees can correctly and safely install and operate the installed equipments and systems, and to better create employment opportunities for the local community and reduce poverty. For example, the "Yellow Phosphorus Tail Gas Recycling Power Generation Project" regularly trains thermal workers and operators in automatic control theory and computer knowledge to better meet the needs of the rapid development of automatic control technology. "The Wengfu Phosphorus Datang Mine Tailings Filling and Mining Technology Project provides sufficient employment opportunities, and recruited staff can be employed after passing the enterprise's training program.

Table 7-5 Measures to improve the standard of living of the local population

Risks and Issues	Mitigation Measure	Monitoring (indicators or reporting)	Implementing Department
The construction	Creating more	Number and percentage of	Demonstration

of the demonstration project may have an impact on the livelihoods of local residents, as well as on minority groups	jobs through the construction of demonstration projects.	employees recruited locally in the demonstration project and record the level of remuneration packages. The number of people who have received alternative livelihood training (by gender and ethnicity)	Project Enterprises
	Skills training for specific jobs	Number of staff training sessions conducted and related records	

7.2.2 Strengthening Care and Support for Women's Groups

The PhosChemEE project should take gender equality and the participation of vulnerable groups into full consideration in the overall implementation process. Therefore, during the construction of the demonstration project, equal participation of men and women in employment, training, environmental risk management, policy formulation, etc. should be actively promoted. In the implementation of the PhosChemEE project, the following principles need to be observed:

(1) Equally ask local community men and women for their opinions and suggestions on project construction.

(2) Establish and actively manage gender-sensitive complaints and grievance mechanisms.

(3) Advocate for equal participation of men and women in demonstration projects.

(4) Make every effort to consult an equal proportion of men and women when developing specific strategies and plans.

(5) Organize relevant training on gender equality.

(6) Guarantee equal pay for equal work for men and women.

(7) Half of the direct beneficiaries of the projects should be women.

Table 7-6 Measures to strengthen care and support for women's groups

Risks and issues	Mitigation measure	Monitoring (indicators or reporting)	Implementing department
Gender discrimination may have negative social impacts as a result of project implementation	Organize regular educational training on gender equality in the construction and operation of demonstration projects	Number of gender training sessions available	Demonstration Project Enterprises
	Promoting equal pay for men and women in positions in the demonstration project	Recording of pay levels for male and female employees; number and percentage of women in positions at	

		different levels of the enterprise	
	Develop and comply with the project's complaints and grievance mechanisms on gender issues	Development of relevant systems	

7.2.3 Establishment of an Emergency Response Plan System for Emergency

As the DPEs are located in mountainous areas and industrial parks in Yunnan, Sichuan and Guizhou, they may develop environmental emergencies and safety emergencies, such as landslides, pipeline leaks and tailing pond breaches caused by heavy rainstorms. Therefore, all DPEs need to set up emergency plans in accordance with the requirements of the relevant state departments, and must implement the requirements they set forth. Establish an open contact channel with the local environmental protection department, so that guidance and supervision from the department can be obtained at any time, and support can be obtained at any time in the event of a dangerous situation. Determine the rescue organization, team and contact method. Formulate the type and level of accidents and corresponding emergency response procedures. Equip with necessary disaster relief and anti-drug apparatus and protective equipment. Formulate emergency status cut-off termination or dose control and automatic alarm chain protection procedures for the production system. Carry out job training and drills, set up accident emergency learning manuals and reports, records and evaluations. Formulate regional disaster prevention and rescue programs, evacuation and evacuation programs for the affected people outside the plant, and establish a better way to contact with the local government, firefighting, environmental protection and medical aid departments, so as to get timely rescue when risky accidents occur.

Table 7-7 Measures to establish an emergency response plan system for emergency

Risks and issues	Mitigation measure	Monitoring (indicators or reporting)	Implementing department
Potential environmental emergencies and safety emergencies may occur, affecting workers and local community residents	DPEs to establish emergency response plans for various types of emergencies	Development of emergency preparedness plans	Demonstration Project Enterprises, Local government authorities
	Establishment of effective contacts with local government, fire, environmental and medical assistance authorities	Provide relevant supporting organizations and contact information	
	Equipped with the necessary	Regular inspections	

	protective equipment and tools	of security production capacity	

7.2.4 Increased Public Participation in Project Construction

In the project involving construction and operation management, the project should be based on extensive consultation with local community residents and groups, strengthen communication with the public, and do a good job of publicizing, explaining and promoting the phosphorus chemical industry chain energy-saving and green and low-carbon enhancement project in an appropriate, steady and effective way, and solve the reasonable demands put forward by the public in a timely manner, so as to avoid that due to the lack of implementation of the work of public participation and the implementation of the relevant environmental protection measures, the leading to environmental disputes and social problems.

Table 7-8 Measures to enhance public participation in project construction

Risks and Issues	Mitigation Measure	Monitoring (indicators or reporting)	Implementing Department
The demonstration project is located in an industrial park or mining area, which may have an impact on the surrounding communities.	Conduct regular local questionnaire surveys during the design, construction and operation phases of the project, respectively, to understand the views and suggestions of the local community regarding the implementation of the project.	Conducting project construction survey work and reporting the survey results.	Demonstration Project Enterprises, Local Government Authorities
	Establishment of public complaints and grievance mechanisms	Publicity of complaint methods and record of complaints	

8. Stakeholders

8.1 Introduction

Stakeholders are individuals, groups or institutions that have interests in the project or have the ability to influence the outcome of the project, which may be either positively or negatively. Stakeholders may be directly or indirectly affected by the Project. The potential impacts of the Project are primarily related to residents in and around the Project implementation area. The implementation of the Project must take

into account all stakeholders and thereby appropriately minimize and compensate for any adverse impacts that may result from Project activities. The formulation and implementation of a stakeholder engagement program, adequate consultation and communication, and public access to information is important measures to ensure adequate stakeholder participation. In addition, industrial park management committees and local governments at all levels are important stakeholders.

8.2 Stakeholder Analysis

Stakeholders are all individuals or groups whose behavior is affected or whose interests are affected by the development of the PCI directly or indirectly involved in the PhosChemEE project. They mainly include the Ministry of Industry and Information Technology (MIIT), the Ministry of Natural Resources (MNR), the Ministry of Finance (MOF), the National Development and Reform Commission (NDRC), the Project Management Office (PMO), local governments, communities (especially ethnic minorities), and non-governmental organizations (NGOs) including the United Nations Development Programme (UNDP), and the All-China Women's Federation (ACWF). Stakeholders are categorized as governmental and non-governmental.

Among them, MOF, MIIT, NDRC, UNDP, and ACWF formed the project steering committee of the project, whose responsibilities to be undertaken include, among others, (1) monitoring the implementation of this ESMF and complying with the national and international regulations as well as UNDP's social and environmental standards; (2) making decisions for taking the necessary measures, including the full integration of management measures in the project outputs and annual work plans; (3) establishing and supporting the GRM mechanism to address any grievances. Plans to fully integrate management measures; and (3) establish and support GRM mechanisms to resolve any grievances.

MIIT, as the implementing partner of the project, shall have the following responsibilities: (1) ensure that required assessments, assessment reports and required management programs are developed, open for public consultation and approval, and that management measures are adopted and integrated during project implementation; (2) report fairly and accurately on the progress of the project in accordance with the agreed work plan, in accordance with the reporting schedule and required format; (3) report fairly and accurately on the progress of the project in accordance with the (3) Maintain documentation and evidence describing the proper and prudent use of project resources

in accordance with signed project documents and applicable regulations and procedures (e.g., SES); (4) Ensure that all requirements of the UNDP SES and national regulatory/policy frameworks are addressed; and (5) Overall management of the project for which UNDP is responsible, including compliance with the UNDP SES.

MNR will be responsible to support MIIT in the implementation of the project activities in phosphate ore mining and refining (Outcomes 1.1 & 1.2 and parts of Outcomes 3.1 & 3.2). It will be responsible for coordinating with the PMO and the participating phosphate mining and refining companies on the implementation of planned technical assistance activities, particularly those on the demonstration activities.

The Project Management Office (PMO) has the following responsibilities: (1) overseeing and managing the implementation of the measures set out in this ESMF; (2) assigning specific responsibilities for the implementation of this ESMF, including oversight of the draft management plan and community consultation, to a staff member of the PMO; (3) maintaining environmental and social risk management-related records, including updated esp, impact assessments, complaint logs, and documentation of management measures implemented; (4) report on the implementation of the ESMF to the implementing partners, the Project Steering Committee, and UNDP; and (5) ensure that all service providers are aware of their responsibilities for day-to-day compliance with the ESMF.

Each stakeholder will be analyzed separately below.

8.2.1 Governmental Stakeholders

(1) The Ministry of Industry and Information Technology(MIIT)

In March 2008, the formation of the Ministry of Industry and Information Technology (MIIT) was completed. As an industry management department, MIIT will formulate industry planning and industrial policies, guide the development strategies and policies of energy-saving and green low-carbon upgrading of the phosphorus chemical industry chain, support the technological updating and equipment upgrading of the phosphorus chemical industry chain, and promote industrial restructuring, innovation and optimization and upgrading. In addition, MIIT will be responsible for monitoring and analyzing the operation situation of the phosphorus chemical industry chain, adjusting policies and measures in a timely manner, and coordinating and solving problems in the development of the industry. At present, MIIT's Department of Raw Material Industry is the competent department and bureau that undertakes the industry

management of raw material industries such as iron and steel, non-ferrous metals, rare earths, petrochemicals (excluding oil refining), chemicals (excluding coal fuel and fuel ethanol, pesticides), and building materials, and coordinates the development of the new material industry, researches the situation of domestic and foreign raw material markets and makes suggestions.

MIIT's concerns about the project may be mainly in three areas: first, the employment impact of industrial restructuring. If the project leads to the adjustment and transformation of the phosphorus chemical industry chain, it may have an impact on the traditional industry chain and jobs that exist in some projects themselves. Second, technological innovation and investment costs. The project requires the industrial chain to implement energy saving and green low-carbon upgrading, which may require enterprises to carry out technological innovation and equipment updating, increasing investment costs and technological pressure, and the project expectations may not necessarily be realized as scheduled; thirdly, in order to achieve the green and low-carbon goals in the project, enterprises may face stricter environmental protection pressure, which may increase the operating costs and management burden of enterprises.

In 2009, the Ministry of Industry and Information Technology's Guiding Opinions on Giving Full Play to the Role of Industry Associations pointed out that it is necessary to further implement the Opinions of the General Office of the State Council on Accelerating the Reform and Development of Industry Associations and Chambers of Commerce (Guo Ban Fa [2007] No. 36) and to give full play to the industry, the communications industry and the related fields of the industry associations, chambers of commerce, societies, and other social intermediary organizations (hereinafter collectively referred to as the associations) The role of associations should be given full play; a mechanism should be set up for associations to participate in the consultation of policy formulation; a system of information exchange should be established; and the competent authorities of the industry, communications industry and informatization should strengthen their ties with associations. For this project, MIIT (Office, Department of Raw Material Industry, etc.) should strengthen communication and contact with China Inorganic Salts Industry Association (CISIA) as well as the Phosphorus Chemical Industry Branch, to keep abreast of the industry's development dynamics and enterprises' needs. Actively respond to enterprise feedback, strengthen

policy guidance and supervision and management of phosphorus chemical industry enterprises, and promote the smooth progress of the PhosChemEE project.

(2) The Ministry of Natural Resources (MNR)

MNR has the responsibilities of uniformly exercising the responsibilities of the owner of all natural resources assets, uniformly exercising the responsibilities of the use control and ecological protection and restoration of all national land space, and is responsible for the rational development and utilization of natural resources, etc. The relevant policies formulated by MNR regulate and guide the energy-saving green and low-carbon development of the phosphorus chemical industry, promote the fulfillment of corporate environmental protection responsibilities, and strengthen supervision and control to ensure the smooth implementation of the project and the achievement of the expected results. MNR is also responsible for the development of the phosphorus chemical industry. In addition, MNR provides top-level design for the implementation and management of the PhosChemEE project, supports the research and development and promotion of energy-saving and environmental protection technologies, provides technical consulting and guidance, promotes cooperation and communication among the government, enterprises, scientific research institutes and social organizations, and forms a mechanism for joint research and development, so as to jointly promote the energy-saving and green low-carbon development of the phosphorus chemical industry, and to achieve the sharing of resources and mutual benefits. In terms of project roles, MNR, as the responsible party of the project, focuses on and supervises the use of resources, technological innovations, and the construction of relevant systems and standards of the PhosChemEE project, in order to effectively improve the efficiency of energy and resource utilization, and is not only a developer of relevant policies, but also plays a central role in leading and coordinating the project stakeholders.

(3) The Ministry of Finance(MOF)

The main functions of MOF include formulating strategies, plans, policies, and reform programs for fiscal and taxation development and organizing their implementation; drafting draft laws and administrative regulations on fiscal, financial ,and accounting management; formulating departmental rules and regulations; and supervising their implementation.

In order to implement the Measures for the Administration of Loans and Grants from International Financial Organizations and Foreign Governments (Decree No. 38 of

the Ministry of Finance of the People's Republic of China), to effectively strengthen the management of GEF-funded projects, to clarify the division of responsibilities for the management of funded projects, to standardize the procedures for applying for and approving the funded projects, implementation, supervision and inspection, and to further improve the efficiency of the use of the funds, the MOF issued the "Measures for the Management of the GEF Grant Projects In June 2007, MOF issued the "GEF Grant Project Management Measures" to effectively strengthen the management of GEF grant projects, clarify the division of responsibilities for grant project management, standardize the procedures for grant project application, approval, implementation, supervision and inspection, and further improve the efficiency of the use of the grant funds.MOF will carry out reasonable supervision of the use of funds in the course of the project implementation and carry out regular project inspections and performance evaluations, and the PhosChemEE project should also submit the progress report, annual work plan, annual forecast, and annual budget to the GEF for review and approval. Report, annual work plan, annual budget and audit report to MOF.

(4) The National Development and Reform Commission(NDRC)

The main functions of NDRC are to formulate and organize the implementation of national economic and social development strategies, medium- and long-term planning and annual plans; and to organize the formulation of comprehensive industrial policies. It coordinates major issues in the development of primary, secondary and tertiary industries and integrates relevant development plans and major policies; implements sustainable development strategies, promotes the construction and reform of ecological civilization, and coordinates ecological environmental protection and restoration, energy and resource conservation and comprehensive utilization.

(5) The Ministry of Ecology and Environment (MEE)

It is responsible for the establishment and improvement of the basic national ecological environment system, and the coordination, supervision and management of major eco- environmental issues. It also takes the lead in coordinating the investigation and handling of major, major and large environmental pollution accidents and ecological damage incidents, guides local governments' emergency response and early warning of major and large ecological and environmental emergencies, and takes the lead in guiding the implementation of the compensation system for ecological and environmental damage. It also supervises the implementation of national emission

reduction targets and is responsible for the monitoring, supervision and management of environmental pollution prevention and control (air, water, ocean, soil, noise, light, odor, solid waste, chemicals, motor vehicles, etc.). It is responsible for the supervision and management of ecological environment access and conducts environmental impact assessment on major economic and technological policies, development plans and major economic development plans, formulating and organizing the implementation of the ecological environment access list.

(6) Local government agencies in demonstration projects

Provincial, city, county, township and village government units in the demonstration project jurisdictions will be key partners in the implementation of the PhosChemEE project. Local governments play the following four main roles in the implementation of the PhosChemEE project: first, they can support the implementation and promotion of the project by formulating specific policy documents, guiding documents, or planning programs; second, they can deploy and provide the necessary resources, such as financial funds, land resources, technical support, etc.; third, the local government, as the direct management body of the project implementation, is responsible for the project's approval, ratification, and filing; fourth, they can coordinate the interests of all project parties and facilitate the relationship between government departments, land resources, and technical support, and filing work. Fourth, it can coordinate the interests of all parties to the project, promote communication and cooperation among government departments, enterprises, social organizations, and the public, and promote the smooth implementation of the project. Project activities will be closely coordinated with local government units.

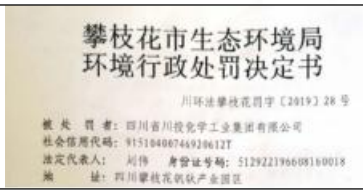
The concerns of the local government are mainly based on two aspects: firstly, the impact on the local economic development due to the cost increase and industrial transformation that may be brought about by the PhosChemEE project, and secondly, the social instability that may be triggered by the PhosChemEE project, such as the reduction of traditional jobs, and the allocation of resources in the process of project implementation.

The PhosChemEE program's communications with local governments are disclosed below:

Table 8-1 Demonstration Project Enterprise communication

Demonstration Site	Communication	Communication department	Relevant documents

Guizhou Kailin Mining and Fertilizer Co., Ltd.	Approval of the environmental impact statement for the project	Guiyang Ecological Environment Bureau	
	Comments on the review of the project's energy efficiency assessment report	Kaiyang County Bureau of Industry and Information Technology	
	Project water abstraction license application for granting water administrative license decision letter	Xifeng County Water Management Bureau	
	Project Soil and Water Conservation Program Approval	Xifeng County Water Management Bureau	
	Proof of project filing	Kaiyang County Bureau of Industry and Information Technology	
Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.	Enterprise investment project record certificate	Anning Development and Reform Bureau	
	Approval of the environmental impact report for the project	Kunming Bureau of Ecology and Environment, Anning Branch	
	Project Energy Efficiency Review Comments	Anning Development and Reform Bureau	

	Environmental Impact Assessment Document Approval Decision	Kunming Bureau of Ecology and Environment, Anning Branch	
	Environmental Impact Assessment Report Acceptance Public Notice	Kunming Bureau of Ecology and Environment, Anning Branch	
	Resolution on Environmental Administrative Penalties	Kunming Bureau of Ecology and Environment, Anning Branch	
Zhonglicheng Industrial Co., Ltd.	Approval of the environmental impact report for the project	Sichuan Environmental Protection Bureau	
	Approval of the environmental impact report for the project	Panzhihua Environmental Protection Bureau	
	Approval of the environmental impact report for the project	Panzhihua Environmental Protection Bureau	
	Environmental Impact Statement Review Comments	Ministry of Ecological Environment of the People's Republic of China	
	Environmental Impact Report Approval	Panzhihua Ecological Environment Bureau	
	Resolution on Environmental Administrative Penalties	Panzhihua Ecological Environment Bureau	

	Environmental Impact Report Approval	Panzhihua Ecological Environment Bureau	

8.2.2 Non-Government Stakeholders

(1) Local communities

The local communities in which the PhosChemEE project is located are concerned not only with improving their own economic standard of living but also with sustaining their social and cultural well-being. The implementation of the PhosChemEE project in the local area is likely to benefit the local population due to the increase in employment opportunities and the environmental benefits of the project. Therefore, local communities should be considered important stakeholders of the PhosChemEE project, as key participants in the project, and their interests and needs need to be fully taken into account and actively communicated and cooperated with to ensure the smooth implementation of the project and maximize the economic, social and environmental sustainability of the project.

Specifically, local residents can be categorized into two groups: those around the upstream phosphorus mining area and those around the phosphorus chemical park. Particularly important stakeholders are the residents around the phosphorus mines and phosphorus chemical clusters, including Niuchang Town in Fuquan City, Xigou Village in Gaozhuoying Township, Mabian Yi Zizhixian, Dashugou Industrial Park in Jinzhong Township, Guiyang City, the area around Dianchi in Kunming City, the Vanadium-Titanium Hi-Tech Development Zone in Panzhihua City, and Caopu Street in Anning City.

In terms of empowerment, the local communities in which the planning project intervenes are among the main beneficiaries of the project, and play a central role in engaging local people and promoting local economic and industrial development. The views of the local communities are crucial for the development of appropriate alternative livelihoods for the local people and are therefore potential partners.

For the area where the demonstration project is located and the neighboring communities, the main social impacts of the project implementation also differ according to their own circumstances. The host community bears the main negative social impacts as project implementation may impose restrictions on resource utilization,

industrial structure, and employment demand in the area, while the negative impacts on other villages in the host area, as well as neighboring communities, are in decreasing order. Considering that the PhosChemEE project has made important practices in terms of energy saving and greening, which may lead to the improvement of natural and environmental conditions in the neighboring communities, the impacts of the PhosChemEE project on the neighboring communities are mostly positive from this perspective.

In the project, special attention should be paid to the vulnerable groups in the local community, such as women, the elderly, children, and the disabled. Vulnerable groups such as women, the elderly, children, the disabled, etc. may lack productive skills and find it more difficult to adapt to changes in their own socio-economic situation.

The impacts of specific demonstration projects on the local community and surrounding residents are analyzed as follows：

1) Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.

There are no residents or other important facilities within the comprehensive utilization of the phosphogypsum project site. The northwest side of the site is the turnover site of Longfeng Turnip; the initial dam is located in the Longfeng Turnip gully in the north, and in the later stage, it is gradually discharged to the south-east direction and gradually utilizes the open quarry of the Longshu section of Songping Longshu Phosphorus Mine. The phosphogypsum turnover site is more than 1km away from the Mantis River, the water plant, and the residential area in the north and is separated by a mountain. To the south and west of the site, it is more than 1km from the Kunshan Steel plant and is separated by a turnip ditch. To the east and to the northeast of the site, there are mountains higher than the site. Residential areas to the west of the site are more than 1km away and are located upstream of the turnip ditch. Residential areas downstream of the site are more than 3km from the initial dams.

2) Guizhou Kailin Mining and Fertilizer Co., Ltd.

The project is constructed in Dashugou Industrial Park, Kaiyang County, Guiyang City, Guizhou Province (see Figure 7-2 and Figure 8-3). The project site and evaluation scope do not involve cultural relics building control lots, no military facilities, no nature reserves, scenic spots, drinking water source protection zones,or important political and cultural zones, and have no impact on cultural heritage and ethnic minority customs; they are not in restricted development zones or prohibited development zones; and they

are not in environmentally sensitive zones, such as basic farmland protection zones, soil and water erosion prevention and control zones, and rocky desertification sensitive zones. It is in line with the relevant regulations on the ecological protection red line zone in the Interim Measures for the Management of the Ecological Protection Red Line in Guizhou Province (Qianfu Fa [2016] No. 32). The wastewater discharged by the project relies on the sewage treatment station of the Mining and Fertilizer Company, and all of it will be reused for production after treatment, and the project will have less impact on the environmental quality of Yangshui River after completion.

The environmental assessment report of the project has elaborated on the environmental elements and environmental protection objectives (Figure 8-1 and Table 8-2).

Table 8-2 Ambient air protection objectives

Name	Cordinate		Protected object	Protect the content	Environmental functional area	Location compared with the plants	boundary distance far from the factory/m
	Longitude	Latitude					
Suanzaoping	106.86882	27.15367	9house/31persons	ambient air	《Environmental air quality standards》(GB3095-2012) third grade	E	1038
Cangbei	106.88268	27.15463	40hosue/115persons			E	2296
Rshuigou	106.87157	27.14848	23house/80persons			SE	1166
Dazhai	106.88054	27.14833	25house/98persons			SE	1886
Xiaojiapo	106.88513	27.14883	10house/32persons			SE	2494
Anda village	106.88221	27.13828	15house/48persons			SE	2419
Saoqitian	106.84316	27.13256	21house/60persons			SW	2416
Shuangshan	106.83389	27.12591	5house/16persons			SW	2466
Banjiujing	106.83874	27.14760	4house/13persons			SW	2130
River Dike	106.83826	27.16448	26house/90persons			NW	2124
Wangjiagou	106.83972	27.16295	19house/67persons			NW	2300
Chayuanpo	106.85552	27.16127	50house/160persons			N	1058
Caotu	106.85234	27.16654	20house70persons			NW	1292
fengyanhe	106.84436	27.17746	12house/36persons			NW	2333
tianniuqiao	106.86779	27.16708	23house/81persons			NE	1268
xinpo	106.87907	27.16967	29house/74persons			NE	1626
huangnijian	106.87509	27.17509	51house/179perso			NE	2382

			ns				
yangwanglong	106.88779	27.17296	37house/130persons			NE	3072
Sand plant	106.87380	27.16433	48house/120persons			NE	1096
Datiankan	106.88324	27.15830	65house/230persons			NE	2054
Yanghe RIver				the earth's surface water	《Environmental quality standards for surface water》(GB3838-2002)IV	E	150
Fengyan River	=		=			N	1750
Heba sprig(Q1)	106.83990	27.15723	Agricultural water	undergr ound water	《Groundwater quality standard》(GB/T14848-2017)Ⅲ	NW	2230
Six barrels of spring point(Q2)	106.84865	27.15944	Agricultural water			NW	1650
CAOTU SPRING POINTsite(Q3)	106.85238	27.16524	Agricultural water			NW	2150
Catyuanpo site(Q4)	106.86178	27.16234	Agricultural water			N	1027
Hot ditch spring point(Q5)	106.87109	27.14825	Agricultural water			SE	850
Big water spring point(Q6)	106.86191	27.14760	Agricultural water			SW	548

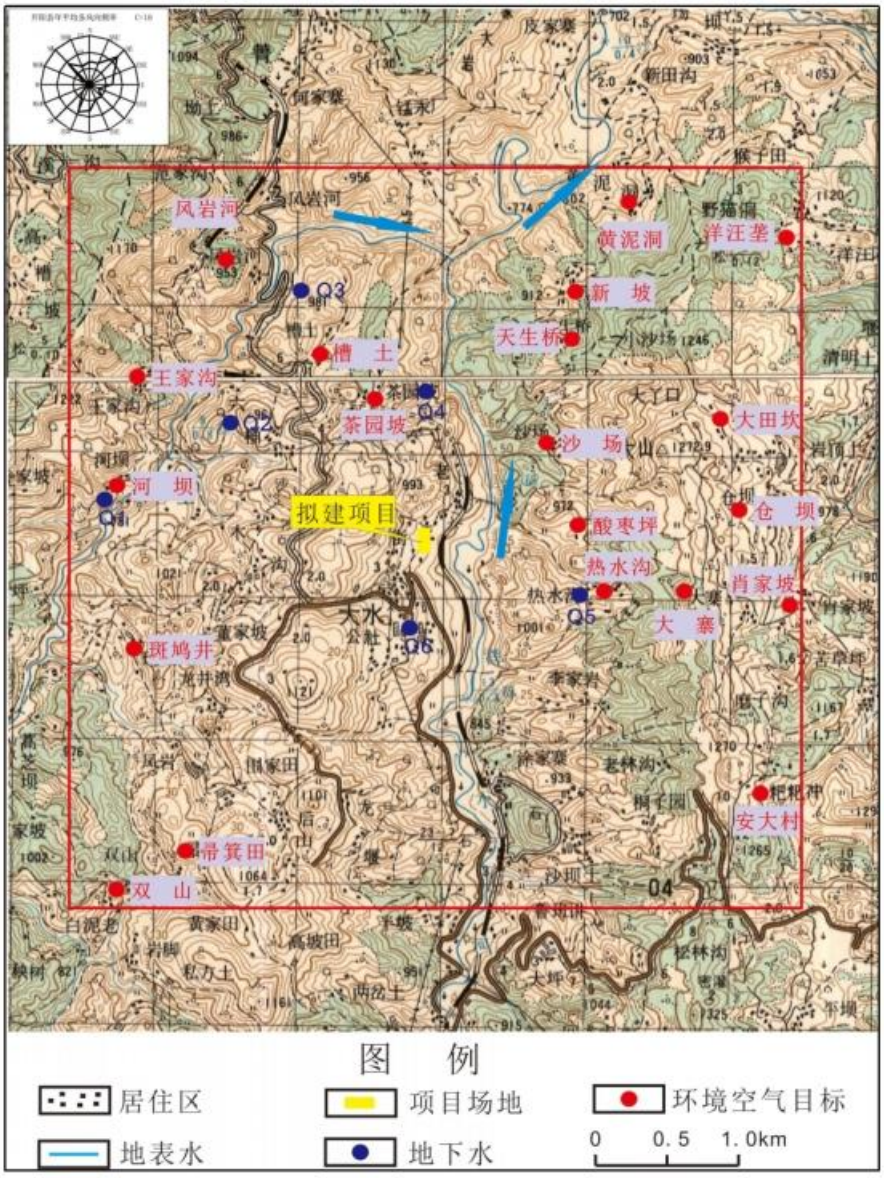


Figure 8-1 Environmental protection target map

It should be noted that, according to the Ecological Functional Zoning of Guizhou, the project is located in the Central Humid Subtropical Karst Fragile Ecological Zone. The area is characterized by karst landscape, sensitive rocky desertification, high ecosystem vulnerability and the need to protect important ecological functions such as water conservation, soil preservation and biodiversity.

Figure 8-2 Project site and surrounding communities

Figure 8-3 Schematic map of the project site

3) Yunnan Phosphate Chemical Group Co., Ltd.

The project is located in the Dianchi basin, which is the main area of Yunnan Province for the distribution of phosphate resources, and thus developed into a mining area, referred to as the "five mining areas". In recent decades, the "five mining areas" have suffered serious ecological damage, and in order to repair the environment and ensure sustainable development, relevant restoration measures have been carried out for the mining areas that have been seriously damaged. According to the different factors of restoration construction, the restored mining areas are divided into four categories: landscape recreation type, ecological conservation type, development and utilization type, and retention and mining type, among which, the scale of landscape recreation type is about 26.57 square kilometers, which can be designed in the restoration of the use of certain landscape recreation function, and can carry out tourism, recreation, science education and other activities in the mining area.

The specific location of the mining area is located in the southwest of Dianchi in Kunming City, Yunnan Province (blue marking in Figure 8-4 below). Through field research and Gaode map search for villages and settlements within 1km of the industrial park, three villages, Xianhe Village, Xihanying Village (Marker 4), and Xincun Village (Marker 5), were found (see Figure 8-5 below). Considering that the demonstration project is characterized by the resource utilization of phosphorus tailings and the use of phosphorus tailings for ecological restoration of the air-mining area, it restores the surrounding ecological environment and achieves the purpose of integrating into the ecosystem and restoring the land, which has certain environmental benefits. In addition, the neighboring villages rely on the phosphorus mine to develop derivative industries, and since the project is located in the original industrial park and does not occupy village land, this report believes that the construction and operation of the demonstration project, although it may have a negative impact on the surrounding environment and the quality of life of the residents, the overall impact is controllable.

Figure 8-4 Schematic map of the project site

Figure 8-5 Project site and surrounding communities

4) Sichuan Development Tianrui Mining Co., Ltd.

The project is located in Xinigou Village, Gaodroying Township, Mabian Yi Autonomous County, Sichuan Province. According to the Gaode map to check the villages and settlements within 1km of the industrial park, it is found that in addition to the village where the project is located, there are also three villages, namely, Kailipu, Ernuo Lekou, and Dafengdeng Village (Marker 4) (see Figure 8-6 below). According to the satellite map, project report, and research, the mine area is characterized by high mountains and deep valleys, rolling hills, steep slopes, deep valleys, and steep mountainous terrain. Therefore, although the three villages mentioned above are within 1km of Xinigou Village in planimetry, the demonstration project will have less impact on the neighboring villages and settlements due to the existence of mountainous obstacles.

The project is constructed on industrial land that has been approved and does not occupy agricultural or grazing land, so it will have less impact on the original production and lifestyle of the local villages. However, it should be noted that the project has a spillover impact on the residents of the village where it is located. Due to the large difference in terrain elevation in Xinigou Village, soil erosion is more serious, and the project needs to pay attention to the increased soil erosion and damage to the natural environment brought about by phosphate mining.

In addition, there are no famous and ancient trees, rare wild animals, or plants that need special protection according to national regulations within the occupied area of the industrial site of the project. There are no ancient tombs, ancient temples, or other cultural relics within the project area, which will have less impact on the local natural and social heritage.

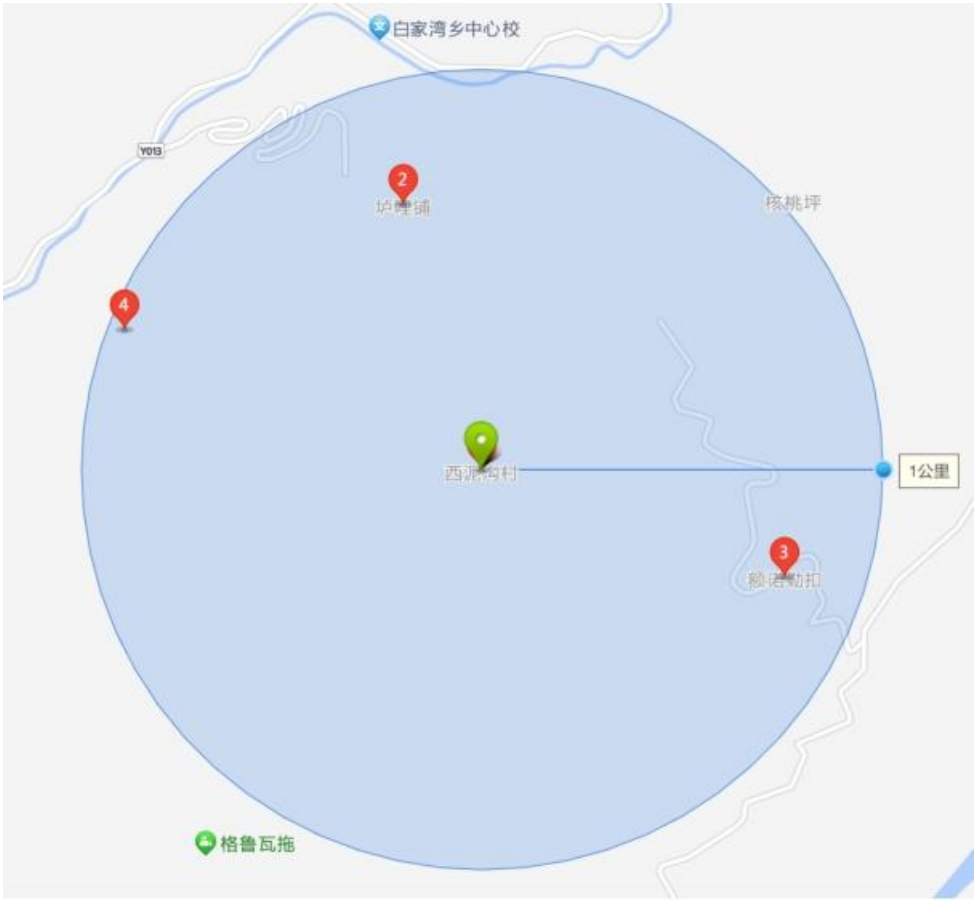


Figure 8-6 Project site and surrounding communities

5) Zhonglicheng Industrial Co., Ltd.

The project is located at No.1 Vanadium-Titanium Middle Road, Vanadium-Titanium Hi-Tech Industrial Development Zone, Panzhihua City, Sichuan Province. Relying on the Gaode map to search for villages and settlements within 1km of the industrial park, it is found that there are three villages, namely, Upper Preserved Fish, Yutang Village (Marker 2) and Preserved Fish (Figure 8-7). Due to the lack of satellite map data, it is impossible to judge the specific topography and terrain of the area. Based on the network information, it is presumed that the project area is located in flat terrain, and there are no mountains around to separate the project area from the surrounding villages, so the impacts of the project's construction and operation on the surrounding villages and settlements should be fully considered.

Specifically, it is mentioned in the overview of the project proposal that before the implementation of the project, the company's normal annual output of 60,000 tons of industrial yellow phosphorus, the by-production of yellow phosphorus tail gas is about 216 million Nm^3. However, the utilization rate of the yellow phosphorus tail gas is less than 30%, and the remaining 70% will be burned directly and the flue gas will be

discharged directly. After the project is implemented in 2019, the utilization of tail gas can be completely realized, and the emission of other pollutants will be reduced to a certain extent. However, the project implementation report does not describe the possible impacts on neighboring settlements and targeted environmental measures.

In addition, the demonstration project is located in the upper Jinsha River valley, which has important ecological value for local residents. Therefore, the project should also pay more attention to the environmental pollution generated by the construction of the project, especially to ensure that no production wastewater is discharged to pollute water bodies; and to pay real-time attention to and monitor the quality of the groundwater, so as to ensure the quality of water for residents' normal lives.

Figure 8-7 Project site and surrounding communities

6) Guizhou Wengfu (Group) Co., Ltd

The existing works of this demonstration project involve the Xinlongba Concentration Plant, Baiyan Tailings Depot, Concentrate Slurry Conveyance Pipeline and Machangping Dewatering Project. Its geographic location is as follows.

The location of the Wengfu-phosphorus mine is Shengchang Town, Fuquan City, and Xinlongba Concentrator under Wengfu-phosphorus mine is located at the site of Xinlongba Village, Niuchang Town, Fuquan City. There are no sensitive areas such as nature reserves, scenic spots, cultural relics, and monuments protection units within 500m around the project processing plant, 500m around the tailing pond, and 200m on each side of the concentrate conveying pipeline. The project's phosphorus concentrate

conveying and backwater pipeline passes through the Shijin Valley Scenic Spot in Fuquan City, but the pipeline is downstream of the built scenic spot, and it is still a long way from the core of Shijin Valley Scenic Spot --- Black Wind Lane Scenic Spot. --However, the pipeline is downstream of the built scenic area, which is still about 1.5km away from the core area of Shajin Valley Scenic Spot. According to the division of environmental elements, the environmental protection targets of the main works of the project are determined in Table 8-3, Table 8-4 and Table 8-5.

In addition, in the project report, the environmental impacts of the project during the construction period, the operation period, and the tailing pond, including the impacts on local residents, are analyzed respectively and targeted environmental protection measures are requested. Specifically, there are the following three main aspects: First, the project occupies arable land, will change the soil type and fertility of the occupied area, affecting the growth of local vegetation, coupled with the construction process will be stripped and pressed into occupation of the excavation area and the crops on both sides of the adverse impact on agriculture, according to which the construction unit in accordance with the standards of national laws and regulations to take land requisition compensation program. Secondly, the project has less impact on the local groundwater and residential water consumption; on the one hand, the project draws water from small dams and deep wells and draws a small amount of water, and the surrounding living residents use water from the village gully springs; on the other hand, the production area of the plant and the storage and transportation facilities area, including the wastewater collection system, piping area, product storage facilities, etc. should be done in accordance with the specifications of the impermeable treatment, and the project is located in the region where the underground diving is buried deeper, bedrock overlaying the soil, except the Steep ditch, gully and other parts of the thin clay sandwiched gravel, are red clay, for a good natural water barrier and seepage control layer. Thirdly, due to the construction of the project, 15 households need to move away from the tailing pond area, and the quality of life of the residents will be guaranteed by means of demolition and relocation compensation.

Table 8-3 Environmental protection targets around the project processing plant

Serial	environmental element	protection object	placement	Scale of protection	Protection level
1	Underground water	Matian River	300m east of the plant	River	Environmental Quality Standard for Surface Water (GB3838-2002) Class III

2	Ecological environment	Soil, vegetation	Within 500m of the surrounding area	Within 500m	Reducing the occupation of land and vegetation, and safeguarding the growth of crops from the effects of external exhaust gases
3	Ambient air	Matian village	110m northwest of plant boundary	18 households, about 75 persons	Implementation of Ambient Air Quality Standards (GB3095-1996) before 2016 and Ambient Air Quality Standards (GB3095-2012) after 2016
		Xinlongba	300m southwest of plant boundary	8 households, about 33 persons	
		Xu family courtyard	600m northeast of plant boundary	14 households, about 60 persons	
		Mt Paomu	600m southeast of plant boundary	6 households, about 25 persons	
4	Acoustic environment	Matian village	110m northwest of plant boundary	18 households, about 75 persons	Acoustic Environment Quality Standard (GB3096-2008) Class II
5	Surface water	Groundwater within 500m of the project and surrounding area	-	Domestic water for residents within 500m of the surrounding area	Groundwater Quality Standard (GB/T14843-93) Class III

Table 8-4 Environmental protection targets around the project tailings pond

Serial	environmental element	protection object	placement	Scale of protection	Protection level
1	Ecological environment	Soil, vegetation	Within 500m of the project and its surroundings	Soil, grassland within 500m	Reduced land occupation, vegetation
2	Ambient air	Residents of the village of Xiaba	250m downstream of the tailings pond	3 households, 11 persons	Implementation of Ambient Air Quality Standards (GB3095-1996) before 2016 and Ambient Air Quality Standards (GB3095-2012) after 2016
3		Residents of the village of Xiaba	400m downstream of the tailings pond	5 households, 18 persons	
4		Residents of Baiyanjiao	500m downstream of the tailings pond	7 households, 23 persons	

5		Residents of Xia Long Village	SW 1300m	35 households, 123 persons	
6		Residents of Xia Long Village	SW 1380m	5 households, 18 persons	
7		Residents of Gao Ping Village	SW 3300m	4 households, 14 persons	
8	Surface water	Groundwater within 500m of the project and surrounding area	-	Domestic water for residents within 500m of the surrounding area	Groundwater Quality Standard (GB/T14843-93) Class III
		Drinking water for villagers in Baiyanjiao	1200m downstream of the tailings pond		

Table 8-5 Environmental Sensitive Targets along the Project Concentrate and Return Pipelines

Serial	Conservation objective		Concentrate and return lines	
	Object	Protection content	Points of the compass	Distance (m)
1	Yuliang River	water quality	Along the pipeline	200 on both sides of the pipe
2	PiLong River	water quality		
3	KaLong River	water quality		
4	FuQuan County	Soil, vegetation		
5	LongChang ownship	Soil, vegetation		
6	Niuchang township	Soil, vegetation		
7	Xinlongba	Soil, vegetation		
8	Sanjin Valley Scenic and Historic Interest Area	Soil, vegetation, water bodies		
9	By the wayside	Ecological environment		

In summary, through investigation and analysis, this report concludes that the PhosChemEE project will have certain impacts on the production and life of local residents and that in further advancing the assessment of the project, it is necessary to focus on risks in the areas of environment (including the impacts on the water source, the amount and quality of groundwater, etc.), society (including the relocation and resettlement of the residents, etc.), health (including atmospheric pollution, etc.), and

land use (including the reasonable planning and (including rational land planning and utilization, etc.).

Due to insufficient data, there may be a lack of comprehensive understanding of the specifics of each demonstration project, and this report suggests that UNDP should obtain more data or cooperate with relevant departments to gain a more comprehensive understanding of the project and formulate policies and measures accordingly to mitigate the negative impacts of the project on the local population.

(2) Global Environment Facility (GEF) and United Nations Development Program (UNDP)

The UNDP has had a resident office in China for many years, providing a broad spectrum of development assistance, including sustainable management of natural resources, governance, gender equality, and the rule of law.

In terms of roles in this project, the UNDP is the GEF Agency for the project and the PhosChemEE project Coordination Agency. UNDP (as the GEF Agency) oversees the implementation of the project. It will not be executing any project activity apart from the required GEF Agency project cycle management services. It will ensure compliance with the specific instructions that must be followed regarding the financial management requirements to be complied with the IP, as well as ensure that the GEF Minimum Fiduciary Standards Requirements are met by the IP and other designated responsible party/parties at all stages of project implementation.

Specifically, UNDP has the following six responsibilities: 1) to provide oversight on all matters related to safeguards; 2) to inform all stakeholders and rights holders involved in, or potentially affected positively or negatively by, GEF-funded projects of the UNDP's Corporate Accountability Mechanisms (as described below); 3) to ensure that the compliance review and stakeholder response mechanisms are functioning properly throughout the life cycle of the project; 4) Ensure compliance with the SES in the implementation of project activities using funds provided from the UNDP account and take appropriate measures to address any shortcomings; 5) Verify and document that all UNDP SES requirements have been addressed; 6) Provide technical guidance on the implementation of the ESMF and administrative assistance in recruiting and contracting specialist safeguard services (as required), and monitor each project's compliance with the ESMF and the UNDP policies and procedures.

The concerns of UNDP and GEF are mainly in the following six areas: First,

whether the PhosChemEE project is effective in protecting the environment and reducing pollution and ecological damage; although the project aims to reduce emissions and minimize pollution, the introduction of new technologies and processes may bring unknown environmental risks, such as new chemical emissions or waste treatment problems. Second, some new green and low-carbon technologies and equipment may have negative impacts on local ecosystems; for example, the construction of new energy-saving facilities or factories for treating pollutants may require the consumption of a large amount of land and resources, leading to ecosystem damage and loss of biodiversity. Third, the possible negative impacts of project implementation on local communities, including land acquisition, changes in job opportunities, and changes in social structure. Fourth, the PhosChemEE project involves the introduction of new energy-saving, environmentally friendly, and green low-carbon technologies, but there is uncertainty as to whether these technologies can be sustained and work in the long term and if the technologies are not transferred and applied properly, this may lead to technological obsolescence, equipment obsolescence, and problems with the sustainability of the project. Fifth, it focuses on the sustainability of the project, paying attention to the impact of the project on the local socio-economy and whether it takes into account social responsibility. This includes consideration of the project's social benefits, community participation, employment opportunities, etc., to ensure that the implementation of the project is in line with the principles of sustainable development. Sixth, it is concerned about the policy support and environmental management capacity of the government where the project is located and whether the project has received active cooperation and support from the government. This includes consideration of the government's environmental policies, regulatory enforcement, and supervisory capacity to ensure that the project is legally compliant and policy-supportive.

(3) China Inorganic Salts Industry Association(CISIA)

CISIA, to which the PhosChemEE project belongs, and the Phosphorus Chemical Branch are important stakeholders. CISIA was approved by the State Council and registered in the Ministry of Civil Affairs on November 14, 2002, as a national social organization under the supervision of the State-owned Assets Supervision and Administration Commission of the State Council. CISIA currently has 28 branches, including the Phosphorus Chemical Branch.

CISIA operates according to the constitution, carries out activities independently, actively serves the enterprises, strengthens the communication with government departments (especially the MIIT office and the Department of Raw Material Industry), plays the role of a bridge and a link, coordinates the professional chapters, and gathers the overall strength of the industry.CISIA, as an association organization, unites the strength of the industry internally, represents the Chinese inorganic salt industry externally, and strengthens cooperation and exchanges with other industries outside of the country. CISIA, as an association organization, unites industry forces internally and represents China's inorganic salt industry externally to strengthen cooperation and exchange with the industry outside China.

As far as this project is concerned, CISIA has closer ties with local enterprises, governments, and social organizations and is more familiar with the local industrial environment, policies and regulations, and market demand, so it can provide services and support closer to the actual situation of the locality. For this reason, CISIA can play the following two roles in the project: First, CISIA can represent the interests of the phosphorus chemical industry chain, put forward industry opinions and suggestions to government departments and project implementers to ensure that the design and implementation of the project fully take into account the characteristics of the industry and the actual situation, and to promote the benign interaction between the project and the industry. Secondly, CISIA can supervise the implementation process and effect of the project, assess the impact and benefits of the project on the industry, provide independent evaluation and suggestions to government departments and the public, and promote the continuous improvement and optimization of the project.

CISIA's main concerns are mainly in the following three areas: First, the successful implementation of the project will enhance the market competitiveness of the project enterprises, and for some, backward production capacity and highly polluting enterprises may face pressure to transform or even phase out and withdraw. Secondly, the implementation of the PhosChemEE project may mean that enterprises need to improve environmental protection standards further and implement energy-saving and emission-reduction measures, which may increase the cost burden and operating pressure on enterprises and small and medium-sized enterprises (SMEs) in the industry may face pressure to transform or insufficient funds and talents. Thirdly, we are concerned about the adequacy of the government's policy environment and support

measures in the project implementation process. Inadequate implementation of policies or insufficient support may affect the smooth implementation of the project and the healthy development of the industry.

(4) Supporting Companies

As far as the PhosChemEE project is concerned, all kinds of supporting enterprises have provided a full range of support services for the project enterprises in the PhosChemEE project, as follows: raw material suppliers (providing suppliers of raw materials such as phosphate ore, phosphate, etc.), environmental protection equipment suppliers (providing all kinds of environmental protection equipment, wastewater treatment equipment, waste gas treatment equipment, etc.), technical service providers (providing technical consulting, technical support, technological innovation and other services), equipment manufacturers (to provide the project after the upgrade of various types of production equipment, production lines and process equipment), logistics and transportation companies (to provide transportation services for raw materials, products and equipment), training institutions (to provide staff training and skills upgrading services), financial institutions (to provide financing support and financial security) and so on.

The main concerns faced by supporting enterprises may be in the following three areas: first, changes in business demand brought about by the project. In particular, whether there is an increase in demand for environmental protection equipment, technical services and other products and services, and whether they can promptly adapt to changes in market demand and provide relevant products and services while also needing to pay attention to changes in market competition. Secondly, supporting enterprises need to pay attention to the innovation and upgrading of energy-saving, emission reduction and green low-carbon technologies to meet the requirements of project implementation and provide more advanced and environmentally friendly products and services. Third, supporting enterprises are concerned about changes in environmental protection standards and policies, especially the increase in emission standards, pollution control requirements, and the implementation of environmental subsidies and incentives. Fourthly, supporting enterprises are also facing the cost, talent and capital pressure brought about by equipment renewal and technological improvement and are concerned about how to offset the pressure brought about by cost increase by enhancing efficiency and how to attract and cultivate high-quality technical talents.

(5) All-China Women's Federation(ACWF)

Founded on April 3, 1949, ACWF is a mass organization of women of all nationalities and from all walks of life united for further emancipation and development, with focusing on the center and serving the overall situation as the main line of work, contacting and serving women as the fundamental task, and representing and safeguarding women's rights and interests and promoting equality between men and women and women's all-around development as its basic functions. As one of the members of the project steering committee of the PhosChemEE project, ACWF can advocate for the fulfillment of corporate social responsibility, promote women's participation in the PhosChemEE project during the implementation of the project, and safeguard women's legitimate rights and interests during the work process; and advocate for the provision of more employment opportunities for women in the project, and accordingly, provide targeted training programs and career development opportunities. In addition, the project may have some environmental pollution and health risks, and the All-China Women's Federation can provide assistance in monitoring project implementation, putting forward the group's special demands, and providing relevant health testing and medical protection.

8.3 Stakeholder Engagement Plan

The Stakeholder Engagement Program provides a roadmap for stakeholders and project implementers on when, how and with whom to consult and communicate throughout the life cycle of the project. Through public participation, the transparency of project construction is increased. On the basis of widely listening to and adopting the reasonable opinions and requirements of the public and personnel from relevant departments, we strive to make the project design and construction of the project more reasonable and feasible, and to maximize the long-term comprehensive benefits of the construction project.

The construction of the project may have certain adverse effects on the surrounding environment and social environment, directly or indirectly affecting the lives of the people in the neighboring areas; the public, out of their own interests, holds different views on the project and the construction of the project can make the project's planning and design more perfect and reasonable, which is conducive to maximize the project put into operation after the completion of the unity of the social, economic and environmental benefits.

The goal of the Stakeholder Participation Program is to enable all stakeholders to participate in the whole process of decision-making, and through multi-channel information disclosure, full and effective consultation, full expression of public opinion and other participatory activities, and ultimately reach a consensus decision-making results. As a result, the program can help the decision makers of the PhosChemEE project to understand the public viewpoints and opinions as comprehensively as possible, enhance the transparency and feasibility of the project construction, and collect the awareness, attitudes and requirements of the public and social groups on the PhosChemEE project. In additon , it can comprehensively and integrally consider the opinions of the public and social groups and absorb the useful suggestions, so as to make the planning and design of the project more. This will enable the project to be better planned and designed, enhance its sustainability, social acceptance and economic benefits, and facilitate its smooth implementation and achievement of results, while ensuring that the rights of stakeholders are not infringed upon.

The Stakeholder Engagement Program will be explained in four sections: Information Disclosure, Consultation, and Participation of Vulnerable Groups and Ethnic Minorities.

8.3.1 Disclosure of Information

Information disclosure and exchange are the basis for stakeholder participation. The project has and will continue to promote the exchange, transmission, and sharing of information between the project organizer and various stakeholders through various forms such as public announcements, questionnaire surveys, forums, and expert consultations. The project has and will continue to incorporate the views of various stakeholders as much as possible throughout the process and ensure that various stakeholders participate in decision-making through various channels and forms. Information disclosure in this context means providing stakeholders with timely and accessible information about the project and its potential social and environmental impacts to facilitate their meaningful, effective, and informed participation in the design and implementation of the project.

(1) Key information disclosed in this item

Project background and objectives: Disclose background information on the project, including the initiating organization, purpose, and vision of the project. Clarify the main objectives and expected results of the project, as well as the impact of the project on the

environment, economy, and society.

Project Scope and Content: Describe the scope and content of the project, including the various links of the phosphorus chemical industry chain involved, measures and technologies planned to be implemented, and the project schedule and budget.

Stakeholder participation: Describe the roles and degree of participation of each stakeholder in the project, including government departments, enterprises, communities, environmental organizations, international agencies, etc. Describe how to communicate and cooperate with stakeholders to ensure the transparency and fairness of the project.

Environmental and Social Impact Assessment (ESIA): Provide the project's ESIA report, including the possible positive and negative impacts of the project, as well as the related risk management and response measures.

Technology and innovation measures: disclose the energy-saving, environmental protection, and green low-carbon technologies adopted by the project, describe the advancement, feasibility, and applicability of these technologies, as well as their impacts on the industrial chain and the prospects for popularizing and applying them.

Monitoring and Evaluation Mechanism: Describe the monitoring and evaluation mechanism of the project, including the methods and indicators for monitoring the progress and results of the project, as well as the regular evaluation of the project's effectiveness and sustainability.

Public Participation and Information Disclosure: Describe the public participation mechanism and information disclosure policy of the project, including how to communicate with the community and the public, solicit comments and feedback, and publicize relevant information and the decision-making process of the project.

Compliance and Risk Management: Describe the project's compliance and risk management measures, including adherence to relevant laws, regulations, and policy requirements, ensuring the legitimacy and sustainability of the project, and addressing risks and challenges that may arise.

The project needs to ensure that staff of local government agencies and residents of local and neighboring communities are fully aware of the above information. Information disclosure needs to be in both Mandarin and local minority languages to ensure that language does not become a barrier for stakeholders to access information. Information should be disclosed in as diverse a manner as possible to ensure that all stakeholders can access and understand the information.

(2) Recommended method of disclosure of information

Community meetings and symposiums: Organize meetings or symposiums in each affected community to introduce the project background, objectives, content, and impacts to the community residents and listen to their views and suggestions. Consideration can be given to conveying the message through village committees and village representatives to enhance the credibility and impact of the message.

Brochures and posters: Produce project brochures and the posters to introduce important information and progress of the project to residents by posting them in public places in the community, such as village committees, schools, and hospitals. Considering the level of education and the fact that stakeholders in some project areas may not be literate, photographs and infographics should be included in the brochures for ease of understanding. In addition, specialized personnel may be arranged to distribute and explain the brochures to each household in a linguistically and culturally appropriate manner.

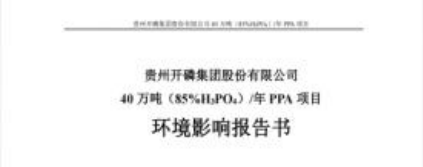
Community radio and television: Use community radio stations or television stations to broadcast promotional videos or information programs about the project to convey important information about the project and ways to participate to residents. Work with local TV to record video interviews to publicize the PhosChemEE project, introduce the GEF, and deliver the message to local residents through TV broadcasts.

Outdoor promotional activities: Organize outdoor promotional activities in the community, such as exhibitions, demonstrations, and bazaars, to attract residents to participate and learn about the project. Student promotional activities can also be conducted in local schools.

Phone calls and SMS: Promote and explain policies and project information to local residents through phone calls and SMS. It should be noted that phone calls, SMS communication (and all other stakeholder engagement efforts) should be done in a linguistically and culturally appropriate manner.

(3) Information disclosure of each demonstration project carried out

Table 8-6 Basic information disclosure of demonstration projects

Demonstration Site	Disclosure content	Disclosure form
Guizhou Kailin Mining and Fertilizer Co., Ltd.		Environmental impact statement

		Environmental impact assessment public participation in the second publicity
		Media disclosure
		Project implementation process disclosure
		Project implementation process disclosure
		Project implementation process disclosure
		Project bidding publicity

		Project facilities completion acceptance report
Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.		Environmental impact statement
		Media disclosure
		Full text information of environmental impact assessment is made public
		Project implementation process disclosure
		Project implementation process disclosure

		Project implementation process disclosure
Zhonglicheng Industrial Co., Ltd.		Public participation in environmental impact assessment
		Environmental impact assessment for public comment
		Project implementation process disclosure
Guizhou Wengfu (Group) Co., Ltd		Environmental impact assessment public participation first public announcement
		Environmental impact assessment public participation in the second publicity
		Project implementation process disclosure
Sichuan Development Tianrui Mining Co., Ltd.		Environmental impact assessment public participation in the second publicity

Yunnan Phosphate Chemical Group Co., Ltd.		Environmental impact assessment public participation first public announcement

8.3.2 Consultations

As a starting point for any Stakeholder Engagement Plan, it is important to consider the key factors in ensuring meaningful, effective, and informed consultation processes, as articulated in UNDP's SES Policy. The specific methods undertaken by the PhosChemEE project team, in adherence to national and UNDP stakeholder engagement requirements, are as follows :

(1) Holding open collective consultation meetings

Organize regular stakeholder meetings, inviting representatives from government departments, business representatives, community leaders, environmental organizations and other parties. At the meetings, discussions and consultations can be held on topics such as the development direction of the project, implementation progress, and solutions to problems, and opinions and suggestions from all parties can be collected to promote communication among stakeholders and solve the problem of conflicting interests of different groups. However, there may be two problems with this approach: on the one hand, it may incur huge costs, especially in demonstration project areas covering large areas and with inconvenient transportation systems; on the other hand, the meeting may involve only a small number of stakeholders and may not represent the voices of all stakeholders.

Therefore, there is a need to gather as many stakeholders as possible, and holding consultation meetings is the most direct way to collect and understand their views. However, the special needs of different stakeholder sub-groups (e.g. women, children, elderly, disabled) should be fully and independently considered. Suitable facilities should be provided for these groups where necessary. Some of the accommodations for these groups are briefly summarized below.

1) Accessible modalities for marginalized and vulnerable groups and persons with disabilities

Communication and interpretation of information: Provide clear and concise information about the meeting, including time, place, agenda, modes of participation,

etc., to ensure that it is easily accessible and understandable to marginalized and vulnerable groups. Provide explanations and supporting illustrations as necessary to help them understand the purpose, significance and impact of the meeting; information should also be provided in an accessible format at the meeting.

Accessibility of venues and facilities: Ensure the accessibility of venues and facilities, such as accessible routes, accessible toilets, etc., to facilitate the participation of marginalized and disadvantaged groups.

Provide support for meals, transportation, accommodation, etc. In some cases, it may be necessary to subsidize lost income (e.g., due to long travel times) and also provide accommodation support where needed to ensure that they are able to participate in the meeting regardless of geographic location.

Ensure that consultations are scheduled at appropriate and inclusive times.

Provide simplified explanations of complex issues and terminology: it is important to take time to ensure that all stakeholders are able to understand and engage with the consultation materials. At times, this may require a targeted approach whereby specific parts of a presentation by a member of a vulnerable group are presented independently of the stakeholder group as a whole.

Provide support staff to assist participants with disabilities, e.g. provide simultaneous interpretation (speech, sign language).

Protect stakeholders from the negative consequences of participation (including private meetings if necessary).

2) Gender- and age-inclusive counseling approach

Gender- or age-specific focus groups and group counseling: Grouping participants by gender and age for discussions creates a more inclusive and comfortable environment where group members are encouraged to share their views and experiences.

Hold separate meetings with women's cooperatives or youth associations.

Gender and age balance: Try to maintain a gender and age balance in meetings or discussions to ensure that the voices of different groups are well heard and represented. This prevents the voices of certain groups from being marginalized or ignored. In addition, consider choosing counseling times and locations that increase gender and age inclusiveness.

Provide childcare during counseling sessions.

Anonymous surveys: Collecting opinions and suggestions through anonymous

surveys allows participants to express themselves more freely without fear of being identified by others.

Multiple forms of participation: Provide multiple forms of participation, including written submissions, oral presentations, group discussions, online surveys, etc., to meet the participation preferences of different gender and age groups.

(2) Meeting with stakeholder representatives

When it is difficult to hold a consultation meeting of all stakeholders, a small-scale meeting with the representatives of stakeholders can be useful. The specific roles are as follows:

1) Promoting information sharing. The meeting provides a platform for various stakeholders to exchange and share information. Through the meeting, the representatives of each party can give a detailed introduction and explanation of the background, objectives, and implementation plan of the project and enhance each other's understanding of the project.

2) Promote the expression of interests. The meeting is an opportunity for stakeholders to express their interests, concerns, and opinions. Representatives of each party can express their own interests, the possible impact of the project on them, and the support or compensation they expect to receive, thus enabling the project organizer to understand the positions and needs of each party more comprehensively.

3) Resolving conflicts and disputes. The meeting helps to discover and resolve possible conflicts and disputes between parties in a timely manner. Through face-to-face communication and exchange, it can promote understanding and consultation among all parties, find ways and means to solve problems, reduce the risk of conflict of interest, and enhance the sustainability and social acceptance of the project.

4) Promote consensus building. The meeting helps to reach a consensus among all parties and form an agreement on the key issues of the project. Through full discussion and consultation, representatives of all parties can reach a consensus on key project issues, formulate common goals and action plans, and push the project forward.

In addition, within the same stakeholder, divergent views may arise, and a number of representatives with different opinions need to be selected to participate in the negotiation to represent the common interests and aspirations of the villagers. The consultation management must conduct due diligence to ensure that the delegates represent the collective views of the communities they represent.

(3) Conducting public opinion polls and questionnaires

Opinion surveys and questionnaires can help collect the views, opinions, and needs of stakeholders and understand their attitudes and expectations towards the project. Through these surveys, it is possible to gain an in-depth understanding of the concerns and demands of various parties, which can provide an important reference for the planning and implementation of the project. At the same time, by analyzing the results of the surveys, potential problems and challenges can be identified, and timely measures can be taken to address them. For example, if it is found that certain communities have insufficient knowledge or misunderstanding of the project, the problem can be solved by strengthening publicity and communication. However, conducting general public opinion surveys and questionnaires in the PhosChemEE Project demonstration project areas may be difficult, costly, time-consuming, and labor-intensive. A more feasible approach is to select a certain sample for the survey randomly. It is important to note that people who are fluent in the local language and understand the local culture should be selected as surveyors to facilitate the work. Prior to the survey, investigators should be systematically trained in the appropriate methods to be used for the effective collection of impartial information.

(4) Information on the consultations that have taken place on PhosChemEE project

1) Overall progress

The PhosChemEE Project Steering Committee has collected the opinions and suggestions of all parties through holding relevant meetings and has fully taken into account their concerns and needs. On this basis, the design and implementation plan of the demonstration project has been continuously adjusted and improved to ensure that the project can best meet the interests and expectations of all parties, as shown in the following Figures 8-8, 8-9, and 8-10 of the relevant media reports.

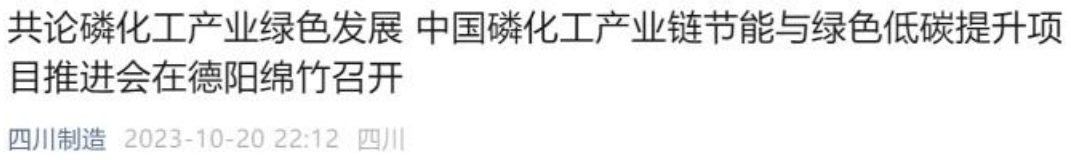

聚焦磷化工行业绿色发展｜中国磷化工产业链节能与绿色低碳提升项目指导委员会第三次会议在昆明召开

地调局成都综合利用所 2024-03-07 16:10 四川

点击上方"地调局成都综合利用所"关注我们

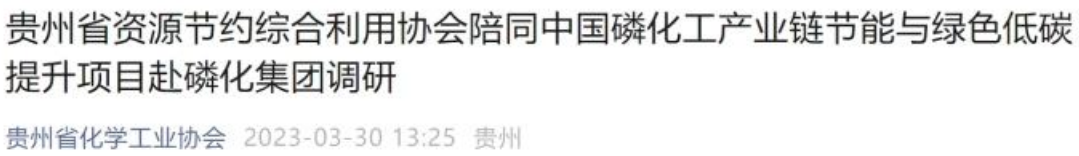
为加快推进中国磷化工产业绿色节能低碳发展，提升磷化工行业能效水平和资源综合利用率，3月5日，中国磷化工产业链节能与绿色低碳提升项目（以下简称"磷化工项目"）指导委员会第三次会议在昆明召开，共商磷化工产业链可持续发展新路径。

Figure 8-8 The third meeting of the PhosChemEE Project Steering Committee


共论磷化工产业绿色发展 中国磷化工产业链节能与绿色低碳提升项目推进会在德阳绵竹召开

四川制造 2023-10-20 22:12 四川

Figure 8-9 PhosChemEE Project promotion meeting


贵州省资源节约综合利用协会陪同中国磷化工产业链节能与绿色低碳提升项目赴磷化集团调研

贵州省化学工业协会 2023-03-30 13:25 贵州

Figure 8-10 PhosChemEE project research consultation

2) Guizhou Kailin Mining and Fertilizer Co., Ltd.

There are 140 surveyors and 10 survey units accepted the questionnaire survey of this project, the public is supportive of the project construction, there are no social groups or individuals opposed to the project; the public believes that the project is conducive to promoting the development of the local economy and solving the problem of employment, and has good economic and social benefits. The vast majority of the public accepts the impacts of the project, but there are still very few individuals who think that the project has bad but bearable impacts on their lives, work, studies and health. In addition, in the safety evaluation report of the Guizhou Kai Phosphorus project, the project enterprise and the construction unit held many consultations and exchanged opinions (see Figure 8-11 below).

第 9 章 与建设单位交换意见

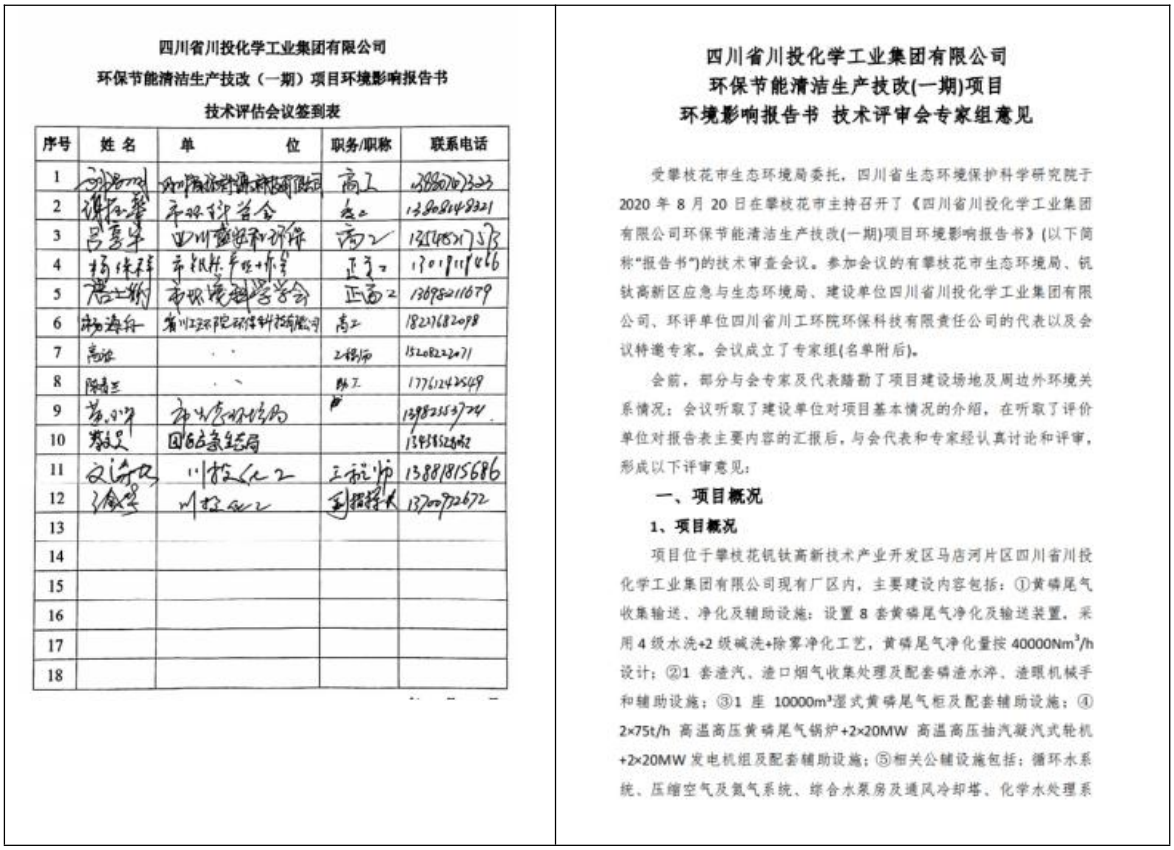
在本次评价过程中多次与建设单位联系联络，从各个方面互通情况，充分商讨、研究交换意见。对我公司提出的一些建设性的意见，建设单位积极落实，在组织新建时参考解决。建设单位对评价报告的内容无异议。

Figure 8-11 Exchange of views in the project safety conditions assessment report

Figure 8-12 Ecological environmental damage compensation agreement mediation case

3) Zhonglicheng Industrial Co., Ltd.

The EIA report of this project shows that the project has carried out information disclosure and public participation in accordance with the Measures for Public Participation in Environmental Impact Assessment (Decree No. 4 of the Ministry of Ecology and Environment), and during the preparation of the EIA report, the EIA information disclosure was carried out by the enterprise in accordance with the law to solicit public opinions. The information disclosure was carried out twice on the website as well as in newspapers and magazines, and no objection was received during this period. However, due to the lack of information, this report did not find the web information during the publicizing period. In addition, the project enterprise invited relevant experts to conduct technical assessment and consultation for this project. Figure 8-13 below shows the sign-in sheet of the experts and the opinions of the expert group at the technical review meeting.



四川省川投化学工业集团有限公司

环保节能清洁生产技改（一期）项目环境影响报告书

技术评估会议签到表

序号	姓 名	单 位	职务/职称	联系电话
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				

四川省川投化学工业集团有限公司

环保节能清洁生产技改(一期)项目

环境影响报告书 技术评审会专家组意见

受攀枝花市生态环境局委托，四川省生态环境保护科学研究院于2020年8月20日在攀枝花市主持召开了《四川省川投化学工业集团有限公司环保节能清洁生产技改(一期)项目环境影响报告书》(以下简称"报告书")的技术审查会议。参加会议的有攀枝花市生态环境局、钒钛高新区应急与生态环境局、建设单位四川省川投化学工业集团有限公司、环评单位四川省川工环院环保科技有限责任公司的代表以及会议特邀专家。会议成立了专家组(名单附后)。

会前，部分与会专家及代表踏勘了项目建设场地及周边外环境关系情况；会议听取了建设单位对项目基本情况的介绍，在听取了评价单位对报告表主要内容的汇报后，与会代表和专家经认真讨论和评审，形成以下评审意见：

一、项目概况

1、项目概况

项目位于攀枝花钒钛高新技术产业开发区马店河片区四川省川投化学工业集团有限公司现有厂区内，主要建设内容包括：①黄磷尾气收集输送、净化及辅助设施：设置8套黄磷尾气净化及输送装置，采用4级水洗+2级碱洗+除雾净化工艺，黄磷尾气净化量按40000Nm³/h设计；②1套渣汽、渣口烟气收集处理及配套磷渣水淬、渣眼机械手和辅助设施；③1座10000m³湿式黄磷尾气柜及配套辅助设施；④2×75t/h高温高压黄磷尾气锅炉+2×20MW高温高压抽汽凝汽式轮机+2×20MW发电机组及配套辅助设施；⑤相关公辅设施包括：循环水系统、压缩空气及氮气系统、综合水泵房及通风冷却塔、化学水处理系

Figure 8-13 Project technical evaluation meeting sign-up form and expert group opinions

4) Yunnan Xiangfeng Environmental Protection Technology Co., Ltd.

The EIA report of the project points out that the project is strictly in accordance with the relevant provisions of the "Measures for Public Participation in Environmental Protection," to make public announcements to solicit public opinions, to reduce the risk of environmental impacts, and at the same time, to formulate effective and perfect emergency response plans for accidents and strengthen the rehearsals, so as to minimize the impacts caused to the environment.

5) Guizhou Wengfu (Group) Co., Ltd

It is stated in the EIA report of the project that, in addition to the public announcement of the situation in the information disclosure link, the reflections of the people from different strata and industries in the vicinity of the project site are investigated through the issuance of Public Opinion Consultation Forms, and for the opinions and suggestions put forward by the public, the solutions will be put forward in the report after consulting with the relevant departments and the construction unit, as shown in the following Table 8-8 and Table 8-9.

In addition, the project also adopts the form of distributing public opinion

questionnaires to survey and solicit opinions from the surrounding residents who may be affected by the construction project. A total of 100 public opinion questionnaires were distributed, and 100 were returned with a 100% return rate. A total of 8 public opinion questionnaires from social organizations and units were returned, with a 100% return rate. In terms of the composition of the public survey respondents, 65 of the participants were male, accounting for 65% of the number of survey respondents; 35 were female, accounting for 35% of the number of survey respondents. The cultural level and occupational composition of the participants are shown in Table 8-10 and Table 8-11.

The survey statistics show that 100% of the public support the project construction and there are no objections. The main environmental protection requirement of public concern is to strengthen the safe operation and management of the tailing pond. The evaluation considers that the public's opinions and requirements on the potential environmental impacts of the expansion project are reasonable and have strong relevance; the construction unit should attach great importance to them and adopt them seriously.

Table 8-8 Environmental Impact Assessment Public Comment Form

(Community Groups)

Group name (stamped with the official seal)		Company nature	
Project Introduction Guizhou Wengfu (Group) Co., Ltd Wengfu phosphate mining area of medium and low grade phosphate ore comprehensive utilization project is in Gaoping Town, Fuquan City The mineral processing equipment and supporting facilities were expanded in the Xinlongba concentrator area. The total investment of the project was 127.691 million RMB, and 264 new workers were added. The construction site of the project is concentrated in Fuquan city, Guizhou province, which consists of five parts: (1) in the xinlongba concentrator area Expand mineral processing plant and supporting facilities; (2) transform Baiyan tailings pond and increase customers; (3) build phosphorus concentrate transportation pipeline between Xinlongba concentrator and Machengping Wengfu phosphate fertilizer plant, and realize the technical transformation of raw concentrate conveying pipeline Pressure and filter back water; (4) renovate and expand the phosphorus concentrate dehydration facilities and loading system on the site of the original pressure and filter workshop in The Machang Ping Wengfu phosphate fertilizer plant Etc.; (5) Construction of tailings filling system in Datang mine section. Now according to the relevant national regulations, the characteristics of the public opinion. (1) Your attitude towards the project construction: support□ object□ insensibility□			
(2)Your opinion of the current environmental quality status: good □ general□ bad □			
(3)What does you think is the beneficial impact of the construction project: House income□ developing the economy□ protect the environment against pollution □			

(4)The impact of construction projects on your life, work or study and health Have a good impact□ Have a serious impact□ Have a bad influence but affordable□ has/have no influence□
(5)The environmental issues that you are most concerned about after the construction of the project ambient air □ water □ noise□ discard □ ecology□
(6)In your opinion, the main environmental problems generated by the construction project are reflected in the following aspects: atmospheric environment □ water environment □ ecological environment □ acoustical environment □
(7)Can you accept the environmental impact arising from the construction of this project acceptability □ unacceptable cannot be designated as□
(8)Your believe that the beneficial impact of the project is mainly manifested in: revitalize the economy □ Solve employment□ spiritual civilization □
(9)Other comments and suggestions:

Table 8-9 Environmental Impact Assessment Public Comment Form (Individual)

Name	TEl	Gender:	
Professional	Education	Age:	Home Address:
Project Introduction Guizhou Wengfu (Group) Co., Ltd Wengfu phosphate mining area of medium and low grade phosphate ore comprehensive utilization project is in Gaoping Town, Fuquan City The mineral processing equipment and supporting facilities were expanded in the Xinlongba concentrator area. The total investment of the project was 127.691 million RMB, and 264 new workers were added. The construction site of the project is concentrated in Fuquan city, Guizhou province, which consists of five parts: (1) in the xinlongba concentrator area Expand mineral processing plant and supporting facilities; (2) transform Baiyan tailings pond and increase customers; (3) build phosphorus concentrate transportation pipeline between Xinlongba concentrator and Machengping Wengfu phosphate fertilizer plant, and realize the technical transformation of raw concentrate conveying pipeline Pressure and filter back water; (4) renovate and expand the phosphorus concentrate dehydration facilities and loading system on the site of the original pressure and filter workshop in The Machang Ping Wengfu phosphate fertilizer plant Etc.; (5) Construction of tailings filling system in Datang mine section. Now according to the relevant national regulations, the characteristics of the public opinion. (1) Your attitude towards the project construction: support□ object□ insensibility□			
(2)Your opinion of the current environmental quality status: good □ general□ bad □			
(3)What does you think is the beneficial impact of the construction project: House income□ developing the economy□ protect the environment against pollution □			
(4)The impact of construction projects on your life, work or study and health Have a good impact□ Have a serious impact□ Have a bad influence but affordable□ has/have no influence□			
(5)The environmental issues that you are most concerned about after the construction of the project ambient air □ water □ noise□ discard □ ecology□			
(6)In your opinion, the main environmental problems generated by the construction project are reflected in the following aspects: atmospheric environment □ water environment □ ecological environment □ acoustical environment □			
(7)Can you accept the environmental impact arising from the construction of this project acceptability □ unacceptable cannot be designated as□			

(8)Your believe that the beneficial impact of the project is mainly manifested in: revitalize the economy □ Solve employment□ spiritual civilization □
(9)Other comments and suggestions:

Table 8-10 Occupational composition of public participants in environmental impact assessment

Occupational composition of the participants	farmer	worker	Civil servants and others
Number of participants	58	16	26
A percentage of the total population of (%)	58	16	26

Table 8-11 Cultural situation of public participants in environmental impact assessment

The cultural process level composition of the participants	University and junior college	High school and technical secondary school	Junior middle school	Primary school
Number of participants	16	20	55	9
A percentage of the total population of (%)	16	20	55	9

8.3.3 Participation of Vulnerable Groups

Women, children, the elderly, and persons with disabilities are all groups that require special consideration in projects. On the one hand, vulnerable groups are often easily overlooked or marginalized, and projects may have a direct or indirect impact on their lives, livelihoods, and environment. Paying attention to the participation of vulnerable groups can guarantee that their rights and interests are fully considered and protected. On the other hand, the project team should be aware of cultural contexts and different barriers (geographic, physical, attitudinal, informational communication, etc.) that may undermine gender equality participation. For example, women with low levels of literacy or who are marginalized in their particular cultural context may have difficulties accessing information. To address these two aspects, the following measures can be taken: firstly, disseminate information about the project through various media, including notices, leaflets, bulletins, or graphics (to serve the illiterate) in community forums, market days, etc.; and secondly, provide relevant training to disadvantaged groups to enhance their capacity and skills to participate. Necessary support and assistance will also be provided to resolve difficulties and problems they may encounter

in the course of their participation. Third, a feedback mechanism will be established to respond to and deal with the views and suggestions of disadvantaged groups in a timely manner to ensure that their voices are taken seriously and responded to.

In order to promote women's participation in rural activities, the planned activities need to pay attention to women's daily lives and activity locations. A key issue is childcare. Childcare must be available during scheduled consultation hours so that women can attend meetings. The project should budget for childcare at all meetings to ensure women's participation in project activities.

A differentiated approach to engaging with certain groups and communities may sometimes be required to ensure the inclusion and safety of marginalized and vulnerable groups. For example, private meetings may be required to ensure a degree of anonymity. In addition, SES requires that special measures be taken to ensure that appropriate accommodation and facilities are provided for the effective participation of persons with disabilities affected by the project.

Without proper design and consultation, the participation of older persons may be overlooked. In order to ensure the participation of older persons and persons with disabilities, consultations need to be held in accessible locations and appropriate translation, interpretation, and facilitation services must be deployed to ensure their full participation.

8.3.4 Participation of Minority Groups

The participation of ethnic minority groups needs to be taken into account throughout the project cycle to ensure that they are able to engage in meaningful consultation, Free, Prior, and Informed Consent (FPIC) so that their rights and interests are fully considered and protected.

In this project, all six demonstration projects involve ethnic minorities, including the Buyi, Miao, and Yi. Ethnic minorities, as an important part of the indigenous people in local communities, have the right to participate in deciding matters that affect their lives. By involving ethnic minorities in consultations, the realization of a democratic decision-making process can be facilitated, ensuring that the different needs and interests of each group are taken into account, enhancing the legitimacy and acceptability of decisions, and contributing to the sustainable development of the project and society.

Therefore, all activities of the project should ensure that the local ethnic minority

residents are informed and participate in the whole decision-making process. The PhosChemEE project aims to obtain valid information in advance through public opinion surveys and provide the necessary training and education to the ethnic minorities so that they can fully understand the subject and procedures of the consultation. In addition, the Constitution of the People's Republic of China and the Law of the People's Republic of China on State Common Language and Writing clearly stipulate that ethnic minorities have the freedom to use and develop their own languages and writing systems, as well as the freedom to maintain or reform their own customs and habits. Therefore, there is a need to use minority languages in the consultation process and to provide materials and channels of dissemination in multiple languages to ensure a smooth exchange of information.

8.3.5 Establish a stakeholder feedback mechanism

During the implementation of the PhosChemEE project, it is necessary to further establish and improve the stakeholder feedback mechanism to better absorb and adopt opinions from all sides.

(1) Identify stakeholders. The project should first identify all stakeholders who may be affected by the project, based on the analysis in the previous section, the main stakeholders of this project are government stakeholders and non-government stakeholders, which are not detailed here.

(2) Establish communication channels. For government stakeholders, the demonstration project enterprise should establish good communication channels with policy-making authorities under the premise of ensuring the compliance of the project, and keep a close eye on policy orientation and support areas. For non-government stakeholders, the demonstration project enterprise should provide more information disclosure and training, to ensure that they fully understand the objectives and potential impacts of the PhosChemEE project.

(3) Training and education. In order to improve stakeholders' understanding and participation in the project, the demonstration project enterprise needs to provide training and education, especially for non-government stakeholders, including project introduction and objectives, environmental and social impacts, participation and feedback channels and methods.

(4) Timely collection of feedback. Collect feedback from stakeholders through various means, including but not limited to questionnaires, interviews, regular

workshops, public hearings, online forums, and social media.

(5) Analysis and integration. The demonstration project enterprise should systematically analyze the feedback from all parties collected, identify key issues and common concerns. Give priority to the feedback from government stakeholders to ensure that the project complies with policies and regulations. Conduct in-depth analysis of the feedback from non-government stakeholders to identify the potential social and environmental impacts of the project.

(6) Develop and adjust the project implementation plan. Based on actual circumstances and stakeholder feedback, the demonstration project enterprise needs to develop or adjust the project plan, including project objectives and scope, timeline and milestones, budget and resource allocation, risk management and mitigation measures, etc.

(7) Communication and feedback. Maintain continuous communication with all stakeholders and provide timely feedback on project progress and decision outcomes, including regular updates on project status, explanations of decision rationale and basis, and responses to stakeholders' questions and concerns.

(8) Evaluate the effectiveness of stakeholder engagement. The project team should regularly evaluate the effectiveness of stakeholder participation. This can be done through surveys, interviews, and meeting records, among other methods. The evaluation results should be used to improve the feedback mechanism and enhance the effectiveness of participation.

8.3.6 Summarize

The Stakeholder Engagement Plan is a key component of the PhosChemEE project and is intended to provide a clear roadmap for stakeholders and project implementers on how to engage in consultation and communication throughout the life cycle of the project. This program aims to enhance the sustainability, social acceptance, and economic benefits of the PhosChemEE project, thereby facilitating smooth implementation and achievement of results while ensuring that the rights of stakeholders are fully respected.

In terms of PhosChemEE project disclosures, this report compiles disclosures from the six demonstration projects. Four demonstration projects, namely, Guizhou Kailin Mining and Fertilizer Co., Ltd., Yunnan Xiangfeng Environmental Protection Technology Co., Ltd., Panzhihua Zhongli Honest Industry Co., Ltd., and Guizhou

Wengfu (Group) Co., Ltd, have all made more than two inquiries about the disclosure of information during the EIA and project implementation process. However, for the Sichuan Development Tianrui Mining Co., Ltd. and Yunnan Phosphate Chemical Group Co., Ltd. projects, due to the lack of information, only one environmental disclosure inquiry was made, and the degree of information mastery is insufficient and needs to be further assessed.

As far as the consultation status of the PhosChemEE project is concerned, this report has sorted out the consultation status of the overall project and the six demonstration projects, consulted with stakeholders, and strengthened public participation by organizing consultation meetings, technical review meetings, project promotion meetings, questionnaires, and other forms.For the two projects, Sichuan Development Tianrui Mining Co., Ltd. and Yunnan Phosphate Chemical Group Co., Ltd., due to the lack of relevant information, the specific consultation situation needs to be further confirmed.

At the same time, measures and requirements have been proposed for the participation of vulnerable groups (women, children, the elderly, people with disabilities, etc.) and ethnic minorities, and a specific path has been proposed for establishing a stakeholder feedback mechanism to better absorb and adopt opinions from all sides.

Table 8-12 Implementation Action Plan

Type	**Activity**	**Description**	**Implementation unit**	**Time**
Stakeholder engagement	Information disclosure	Through various forms such as public announcements, questionnaires, forums and expert consultation, the exchange, transmission and sharing of information between the main body of the implementation of the demonstration project and various stakeholders will be promoted.	Demonstration project enterprises and local government	2023-2024
	Consultations	Open collective bargaining sessions; meetings with stakeholder representatives; opinion polls and questionnaires.	Demonstration project enterprises	2023-2024

	Promoting the participation of vulnerable and minority groups	Dissemination of project information through various media; relevant training for disadvantaged groups; establishment of a feedback mechanism to respond to and deal with the views and suggestions of disadvantaged groups in a timely manner; use of ethnic minority languages to ensure smooth information exchange.	Demonstration project enterprises	2023-2024

8.4 Grievance Mechanism

8.4.1 UNDP's Accountability Mechanisms

UNDP's SES recognize that even with strong planning and stakeholder engagement, unanticipated issues can still arise. Therefore, the SES are underpinned by an Accountability Mechanism with two key components:

(1) Social and Environmental Compliance Unit (SECU): It primarily responds to allegations of non-compliance with applicable environmental and social policies by UNDP. It focuses on investigating concerns raised by project-affected stakeholders regarding UNDP's non-compliance with its social and environmental standards and screening procedures, and proposes measures to address compliance issues.

(2) Stakeholder Response Mechanism (SRM) : It ensures that individuals, ethnic groups, and communities affected by projects have access to appropriate grievance redress procedures to hear and resolve project-related complaints and disputes. This mechanism facilitates the collaborative resolution of grievances or disputes related to the social and/or environmental impacts of UNDP-supported projects among project-affected stakeholders, UNDP's partners (governments, NGOs, businesses), and other parties.

UNDP's Accountability Mechanism is available to all of UNDP's project stakeholders.

8.4.2 Project-level Grievance Mechanisms

It is necessary to establish a channel to receive feedback from stakeholders for the implementation of policies and projects. Generally, after the relevant stakeholders participate in the activities, the experience and feelings of the participants can be recorded on the spot, as well as encouraging participants to put forward suggestions for

future improvements.

The project will establish a long-term stable feedback and communication mechanism with the Ministry of Industry and Information Technology, the Ministry of Natural Resources, local industrial and information department, local natural resources department, industrial park management committee, etc. Meanwhile, it will actively absorb complaints from local communities, demonstration project enterprise employees, and the general public. Table 8-13 provides an overall process and overview of the dispute resolution mechanism at the project-level. The full details of the complaint resolution mechanism will be determined at the start of the project.Key stakeholders

Table 8-13 Grievance Mechanism Overview

<table>
<tr><th>Community and regional complaint mechanisms around mining areas and industrial parks.</th><th>The target</th><th>Key stakeholders</th><th>The principal responsible agency</th><th>Time</th></tr>
<tr><td colspan="5">(1)A mechanism for resolving complaints from communities around the demonstration project area</td></tr>
<tr><td>Step 1: Provide the contact information of the industrial park or local government department where the demonstration project area is located, and explain how to file a complaint.</td><td>Provide project information to the affected communities and address any complaints promptly.</td><td rowspan="2">Communities affected by the project, male and female farmers, minority farmers.</td><td rowspan="2">PMO</td><td>Take effect immediately</td></tr>
<tr><td>Step 2: Affected stakeholders can lodge complaints with the industrial park or local government department where the pilot project area is located.
Complaints can be lodged by phone, and the call operator will record the complaint.
Complaints can be made in a minority language, and a community liaison officer will translate the content into Mandarin.</td><td>Regardless of gender, ethnicity, or educational background, provide every stakeholder with a fair opportunity to voice their grievances.</td><td>Any time during the project implementation period.</td></tr>
</table>

Step 3: The industrial park or local government authority in which you are located should first communicate and explain/clarify/resolve the complaint, and submit it to the PMO if necessary.	Timely resolve the relevant appeal issues to safeguard the legitimate rights and interests of complainants.			Within 15 working days after receiving the complaint.
Step 4: Explain/clarify/resolve the complaint.				Within 15 working days after receiving the complaint.
(2) A mechanism for resolving complaints filed by workers/unions at demonstration projects				
Step 1: Provide the contact information for the demonstration project enterprise to workers/unions.	Provide project information to workers/unions and promptly address any complaints.	Workers affected by the project, male and female farmers, minority farmers.	PMO	Take effect immediately
Step 2: Affected workers/unions should file complaints to the local committee or demonstration project enterprise. Complaints can be made over the phone and recorded by telephone operators. Complaints can be made in minority languages, and community coordinators will translate them into Mandarin Chinese.	Provide every worker with a fair opportunity to appeal, regardless of gender, ethnicity, or educational background.			Any time during the project implementation period.
Step 3: The Workers' Management Committee first communicates and explains/clarifies/resolves complaints, and submits them to the PMO when necessary.	Timely resolve the relevant appeal issues to safeguard the legitimate rights and interests of complainants.			Within 15 working days after receiving the complaint.

Step 4: Explain/clarify/resolve the complaint.				Within 15 working days after receiving the complaint.
(3) A mechanism for resolving public complaints				
First step: Provide a hotline for public complaint services.	Provide project information to affected community residents and promptly address any complaints.	The affected population, whether male or female, Han Chinese or ethnic minorities.	PMO	Take effect immediately
Step 2: If there are any complaints, submit them to the project management committee.	Regardless of gender, ethnicity, or educational background, provide efficient channels for every resident in the community to voice their grievances.			Any time during the project implementation period.
Step 3: The management committee proposes a solution.	Propose timely solutions to protect the legitimate rights and interests of complainants.			Within 15 working days after receiving the complaint.
Step 4: Communicate with the complainant to resolve the relevant issues.。				Within 15 working days after receiving the complaint.

Note: The term "local government department" refers to local industrial and information technology departments, local natural resources departments, industrial park management committees, and so on.

8.4.3 Ways to Receive Feedback and Maintain Communication

For the implementation of policies and projects, it is necessary to establish a channel for receiving feedback from stakeholders. Specifically, there can be five approaches as follows:

(1) Establish a multi-level feedback channel. This includes setting up an online feedback form on the project website, establishing a dedicated e-mail address, setting up a telephone hotline, etc. Such a multi-level feedback channel can ensure that all types of stakeholders, including enterprises, government agencies, industry associations, and the public, can easily provide feedback.

(2) Regular stakeholder meetings: Regular stakeholder meetings are an important way to maintain communication. These meetings can invite representatives from phosphorus chemical enterprises, environmental protection departments, industry associations, research organizations, and local communities. The meetings can provide an open and transparent platform for all parties to discuss and exchange views on topics such as project progress, environmental policies, and technological innovations. Generally speaking, after the relevant stakeholders have participated in the activities, the experience and feelings of the participants can be recorded on-site, and participants can also be encouraged to make suggestions for future improvements.

(3) Conduct regular surveys and questionnaires: Regular surveys and questionnaires are an important means of understanding the opinions and suggestions of stakeholders. Feedback from all parties on project progress, environmental protection measures, social impacts, etc., can be collected through these surveys, providing valuable references for project decision-making.

(4) Set up a specialized communication team: In order to better manage feedback and maintain communication with stakeholders, a specialized communication team can be set up. This team can be responsible for collecting, organizing, and analyzing feedback and providing timely feedback reports and suggestions to the project management team.

(5) Establish an open and transparent communication policy: Develop and publicize an open and transparent communication policy that clarifies the rights and obligations of all parties when giving feedback, as well as the project team's handling and timeframe for feedback.

For example, after accepting the feedback, Yunnan Xiangfeng Environmental Protection Technology Co., Ltd. implemented and rectified the project implementation

process by issuing the "Disclosure of Rectification and Implementation of Rectification and Implementation of Sloppy Development of Phosphorus Chemical Enterprises and Low Utilization of Phosphorus Gypsum in Phosphorus Chemical Enterprises Feedbacked by the Second Round of Central Ecological Environment Protection Inspectors" (see Figure 8-14 below). The public notice focuses on supporting enterprises to carry out the green transformation of traditional production processes and equipment. 5 comprehensive utilization projects of phosphogypsum, such as Yunnan Xiangfeng Environmental Protection Technology Co., Ltd., were supported by 15.5 million RMB of special funds arranged by the Yunnan Provincial Department of Industry and Information Technology.

Figure 8-14 Publicity of rectification and implementation

8.4.4 Direct Appeal Process

Local community residents can reflect their grievances and requests to the local administrative authority by calling the complaint line, writing a letter of complaint, or going directly to their homes. The staff of the administrative authority staff will receive the complaints directly and submit them to the head of the administrative authority. The management of the administrative authority determines the appropriate person in charge and alternative solutions through discussions at an internal meeting, and the person in charge then communicates with the complainant to convey the proposed solution. If the complainant chooses to accept the proposed solution, the complaint will be resolved. If

the complainant chooses to reject the proposed solution, the institution will report the complaint to the higher authority.

8.4.5 Indirect Appeal Process

Complainants may express their grievances and complaints to the community management. Upon receipt of a complaint, the community management department should first consider resolving the complaint through communication and negotiation at the community level. If the community management department finds that the complaint cannot be resolved through communication within the community, it needs to inform the local government of the complaint in a timely manner. In the end, the community management department will act as an intermediary, and the government agency and the complainant will resolve the complaint with the help of the community management department and satisfy or compensate the complainant's reasonable demands.

8.5 Monitoring and Reporting

Progress in ESIA implementation will be assessed annually, and records of all consultations will be kept and reported on a monthly basis. Any reports of non-compliance (i.e., non-compliance with host country laws or provisions of the UNDP social service system) must be recorded and reported within one week of the complaint. In the event of any individual or community complaints or grievances, UNDP must be notified and ensure that the grievance redress mechanism is adhered to.

The Project Steering Committee (PSC) will take corrective action as necessary to ensure that the project achieves the desired results.The PSC will conduct a project review to assess the performance of the project and evaluate the annual work plan for the following year. In the final year of the project, the PSC will conduct an end-of-project review to capture lessons learned, discuss opportunities for scaling up, and highlight project outcomes and lessons learned to relevant audiences. The final review meeting will also discuss the findings outlined in the End-of-Project Evaluation Report and management's response.

DPEs are responsible for providing all necessary information and data required for timely, comprehensive, and evidence-based project reporting, including complaints, outcomes, and financial data when necessary. Specifically, PhosChemEE projects play a central role in engaging local people and contributing to local economic and sectoral development. They are critical in developing alternative livelihoods for local people and are, therefore, potential partners in the demonstration. The project office will be

responsible for monitoring the ESMP and reporting on its implementation to the UNDP office on a quarterly basis. UNDP will be the senior supplier to the project and program steering committee. The UNDP country office will provide administrative and strategic guidance to the project and support the procurement process, including the procurement of goods and services from international sources. The UNDP-GEF regional technical adviser based at the Regional Center for Asia and the Pacific will provide strategic technical assistance and project assurance.

9. Conclusion

PhosChemEE Project is the facilitation of the extensive application of low-carbon and energy-efficient technologies in the phosphate chemicals industry (PCI) in China. Pre-screening conducted during the development of the PhosChemEE project indicated that a comprehensive form of assessment was required in accordance with UNDP's SES policy due to the "high" risk of the project.

ESIA began with an overview of project-related national legislation, policies and regulations, international agreements and treaties, and UNDP social and environmental standards and found that a number of gaps do exist in national regulatory frameworks, including low legislative authority for cleaner and more energy-efficient production of mineral resources, cross-sectoral synergies and the overall planning effect of policies that need to be strengthened, insufficient support for technological innovations and research and development, local policies that need to be updated, and related policies such as standard-setting that need to be refined. It is to be updated, and relevant policies, such as standard-setting, are to be refined.

By collecting and analyzing the preliminary work documents such as EIA reports and feasibility study reports of the six demonstration projects, and also collecting and collating the relevant socio-economic and environmental baseline data, the environmental risks were assessed in terms of threats to biodiversity/natural habitat conservation, pollution and waste discharge, and climate change, and the social risks were assessed in terms of affected groups/communities, ethnic minorities, land tenure systems, physical resettlement, economic displacement and access restrictions, livelihoods, cultural heritage, gender discrimination, community health and safety, etc. Social risks are assessed. Overall, the social and environmental risks of the project are controllable and have good environmental and GHG emission reduction effects. The main risks of this project are listed in Table 9-1.

Table 9-1 Risk Overview

Risk / Potential Impact	Impact/Risk level
1.The development of upstream phosphate mines may have an impact on the protection of biodiversity and natural habitats along the construction area or pipeline route, as it is carried out through open-pit mining.	Possibility: 1(Slight) Impact: 3(Moderate) Overall Significance Level: Low
2. Demonstration projects may generate pollution and waste emissions, which could have an impact on the ecological environment. Environmental risks mainly focus on sudden environmental accidents related to water and soil pollution. Under normal operating conditions, the risk of routine pollutant emissions is relatively low.	Possibility: 1(Slight) Impact: 3(Moderate) Overall Significance Level: Low
3. The excessive consumption of energy resources and the use of new technologies may exacerbate climate change.	Possibility: 1(Slight) Impact : 2(Minor) Overall Significance Level: Low
4. The demonstration project is located in an industrial park or mining area, which may have an impact on the surrounding community.	Possibility: 1(Slight) Impact: 2(Minor) Overall Significance Level: Low
5. Guizhou, Yunnan, and Sichuan are relatively typical areas where ethnic minorities gather, which may give rise to ethnic minority issues.	Possibility: 1(Slight) Impact: 2(Minor) Overall Significance Level: Low
6. Potential compliance risks brought by the land ownership system.	Possibility: 1(Slight) Impact: 1(Negligible) Overall Significance Level: Low
7.Demonstration projects mainly focus on technological transformation, which may result in improper physical relocation risks.	Possibility: 1(Slight) Impact: 1(Negligible) Overall Significance Level: Low
8.The demonstration projects are mainly located in industrial park areas, which may result in the relocation of local residents and cause economic displacement and access restrictions during the initial construction phase.	Possibility: 1(Slight) Impact: 2(Minor) Overall Significance Level: Low
9.The construction of demonstration projects may have an impact on the livelihoods of local residents.	Possibility: 1(Slight) Impact: 2(Minor) Overall Significance Level: Low
10. The construction of demonstration projects in the area may have an impact on local important cultural relics, historical sites, and scenic spots.	Possibility: 1(Slight) Impact: 2(Minor) Overall Significance Level: Low
11. There is a potential risk of gender discrimination.	Possibility: 1(Slight) Impact : 2(Minor) Overall Significance Level: Low

12. Environmental pollution and the risk of disaster accidents may have an impact on community health and safety.	Possibility: 1(Slight) Impact : 3(Moderate) Overall Significance Level: Moderate

The PhosChemEE project has caused significant negative environmental impacts in the local area, including threats to biodiversity/natural habitats protection, pollution and waste emissions. In terms of biodiversity/natural habitat protection threats, the focus is mainly on the upstream phosphate mining development phase, as it is open-pit mined, which may have an impact on the ecological environment in the construction area or along the pipeline route. For example, the project of Guizhou Wengfu (Group) Co., Ltd passes through the Fuquan Shuijin Valley Scenic and Historic Interest Area, and its phosphate rock conveyance pipeline will cause damage to the shrubs and trees along the pipeline if it leaks. The soil pollution range will affect the vegetation in the protected forest area, and ultimately affect the ecological environment along the pipeline. In contrast, the middle and lower reaches of phosphoric acid production and the comprehensive utilization of phosphogypsum and yellow phosphorus tail gas, which are concentrated in industrial parks, have a lower significant water body threat to biodiversity/natural habitats protection.

In terms of pollution and waste emissions, the focus is on sudden environmental accidents in water pollution and soil pollution. Specifically, the phosphate mining development projects in the upstream area are at risk of pipeline ruptures, tailings dam failures, etc. , which will cause pollution to surface water, groundwater, and soil to some extent. The middle-stream phosphate production and downstream phosphogypsum and tails gas utilization projects are all concentratedly planned in industrial parks, and the overall environmental risk level of pollution and waste discharge under normal operation is relatively low.

In addition, in terms of climate change, the six demonstration sites of the PhosChemEE project involve the efficient utilization of tailings, resource recovery, and phosphate chemical technology upgrading, which have good environmental performance in terms of greenhouse gas emissions reduction, but will also result in additional energy consumption due to the use of new technologies, causing direct or indirect greenhouse gas emissions.

The overall social risk level of the PhosChemEE project is "low," but some key social risks need to be vigilant. The first is that the project construction involves a small

number of migrants, although the original residents have been properly accommodated under the united planning and leadership of the local government, the employment problem of the migrant relocation households will still have an impact. The second is that in the participation of the female group, the demonstration project enterprises generally do not provide more information disclosure on the recruitment, salary, and employment of women, and it is currently difficult to accurately judge gender discrimination problems. It still needs further research and monitoring of the impact of related issues, including the equal participation of men and women in employment, training, environmental risk management, and policy formulation. Third, due to the fact that the demonstration project enterprises are located in mountainous areas and industrial parks in Yunnan, Sichuan, Guizhou and other places, they may encounter unpredictable natural disaster events or sudden events during the construction process, such as landslides caused by heavy rains, pipeline leaks, tailings dam failures, etc. In addition, during the operation of the demonstration project, it involves the risk of flammable, explosive, and toxic and harmful substances leaking, which may pose a threat to the surrounding community residents, demonstration project enterprise employees, etc.

Although the 6 demonstration projects have certain environmental and social risks, on the whole, all 6 projects have adopted advanced production technologies and strictly implemented environmental and social impact standards. Compared with the baseline scenario, which uses the current technology and environmental and social standards in the region, they have great environmental and social benefits. The phosphate recovery rate at the Wengfu phosphate mine project reached 96.84%, the water reuse rate was 95.0%, 5769.4 tons per year of phosphorus was recovered (calculated based on P_2O_5), 2,429,300 m^3 per year of fresh water was saved, and 3,200 t of sulfuric acid was saved, with an estimated direct economic benefit of 42 million RMB per year. The annual stable increase in revenue from the Tianrui project in Mabian County, equivalent to reducing the consumption of 4.2 million tons of original ore resources. The wastewater at Guizhou Keping Phosphate was fully recycled and not discharged. Yunnan Phosphate has carried out industrial application transformation to reduce the P_2O_5 grade of flotation tailings from 7% to 6%, achieving a reduction of P_2O_5 grade in flotation tailings to below 6%, an increase in the recovery rate of concentrates by over 1.5% and the recovery of at least 90,000 tons of concentrates per year, a reduction of 90,000 tons

of tailings discharge per year, and a reduction of raw ore extraction by about 130,000 tons per year. Xiangfeng Environmental Protection has the advantages of rapid recovery of water-soluble phosphorus, reducing phosphorus loss; improving the quality of cement retarder to meet user needs; extending the storage period of slag heap to reduce the operating costs of slag heap; reducing the amount of gypsum extracted, lowering extraction costs; reducing natural water consumption, making it easy to control the system's water balance; and reducing the annual emissions of particulate matter by 60 tons, sulfur dioxide by 1,250 tons, nitrogen oxides by 153 tons, and other air pollutants, all of which can be reduced and meet emission standards. In terms of greenhouse gas emissions, six projects can reduce carbon dioxide emissions by 702,000 tons. In terms of social benefits, the six projects have important promoting effects on the economic and social development of the local area.

In order to avoid or mitigate potential negative environmental and social impacts, it is recommended as follows: In terms of environmental risks, improvements can be made by formulating special mitigation measures in terms of air pollution, water pollution, soil pollution, noise pollution, etc., improving the efficiency of utilization of resources, such as energy, raw materials, water, etc., and lowering the level of GHG emissions, etc., in accordance with the actual situation of the construction of the demonstration project. In terms of social risks, improvements can be made by improving the living standards of local residents, strengthening the care and support for female groups, establishing an emergency plan system for emergencies, and improving public participation in project construction.

This report further develops a detailed stakeholder engagement and monitoring plan. The stakeholder engagement plan is a key component of the PhosChemEE project and aims to provide a clear roadmap for stakeholders and project implementers on how to participate in consultations and exchanges throughout the project's lifecycle. This plan aims to enhance the sustainability, social acceptance, and economic benefits of the PhosChemEE project, thereby facilitating its successful implementation and achievement of project outcomes, while ensuring that the rights of stakeholders are fully respected.

Annex 1：Stakeholder Engagement Overview

1. List of Consulted Personnel

(1) Local Government Administrative Personnel

- Zhao Yu, Director of the Department of Environment and Comprehensive Utilization of Resources, Sichuan Provincial Department of Economy and Information Technology
- Zhang Tao, Director of the Department of Energy Conservation and Comprehensive Utilization, Guizhou Provincial Department of Industry and Information Technology
- He Guoyong, First-Class Principal Staff Member of the Energy Conservation Department, Hubei Provincial Department of Economy and Information Technology

(2) Representatives from Demonstration Project Enterprises

- Chen Shenglun, Guizhou Wengfu (Group) Co., Ltd., 18485423342
- Luo Bo, Sichuan Development Tianrui Mining Co., Ltd., 18382126689
- Dong Haijuan, Guizhou Kailin Mining and Fertilizer Co., Ltd., 13765830750
- Guo Yongjie, Yunnan Phosphate Chemical Group Co., Ltd., 13888035600
- Wang Menghui,Yunnan Xiangfeng Environmental Protection Technology Co., Ltd., 15008409110
- Wang Rui, Zhonglicheng Industrial Co., Ltd., 15808129053

2. List of Issued Policy Documents

(1) National Level

- Implementation Plan for Promoting Efficient and High-Value Utilization of Phosphorus Resources (MIIT Joint Announcement [2023] No. 259)
- Notice of the Office of the Ministry of Natural Resources on Conducting Random Spot Checks and Verifications of Green Mines in 2023 (MNR Natural Resources Office Letter [2023] No. 1017)
- The 14th Five-Year Plan for Industrial Green Development (MIIT Regulation [2021] No. 178)
- Notice on Updating the Catalog of Advanced and Applicable Technologies for Conservation and Comprehensive Utilization of Mineral Resources (MNR Natural Resources Office Letter [2021] No. 2451)

(2) Provincial Level

- Opinions of the Guizhou Provincial People's Government on Comprehensively Strengthening the Comprehensive Utilization of Phosphogypsum and Promoting the Green Development of the Phosphorus Chemical Industry (Guizhou Provincial Government Announcement [2024] No. 5)
- Notice on Issuing the Work Plan for Comprehensively Promoting the Comprehensive Utilization of Phosphogypsum in Yunnan Province (Yunnan Industry and Information Technology Resources [2023] No. 431)
- Implementation Plan for Promoting Energy Conservation and Green Low-Carbon Development in the Phosphorus Chemical Industry in Sichuan Province (Sichuan Provincial Department of Economy and Information Technology and Environmental Resources [2023] No. 101)
- Regulations of Hubei Province on the Prevention and Control of Phosphogypsum Pollution (2022)

3. List of Reviewed Documents

(1) Guizhou Wengfu (Group) Co., Ltd.

- Implementation Plan for the Demonstration Project of Application of Full Tailings Filling Technology in Underground Phosphate Mines
- Feasibility Study Report for the Comprehensive Utilization Project of Low- and Medium-Grade Phosphorus Ore in Wengfu Phosphorus Mining Area
- Environmental Impact Report for the Comprehensive Utilization Project of Low- and Medium-Grade Phosphorus Ore in Wengfu Phosphorus Mining Area (Excluding Tailings Dam)
- Pre-evaluation Report on Safety for the Comprehensive Utilization Project of Low- and Medium-Grade Phosphorus Ore in Wengfu Phosphorus Mining Area (Excluding Tailings Dam)

(2) Sichuan Development Tianrui Mining Co., Ltd.

- Implementation Plan for the Demonstration Project of Intelligent Device and Application of Mixed Acid Preparation for Phosphorus Float Selection
- Feasibility Study Report for the 2 Million Tons per Year Intelligent Device Preparation and Application Project of Mixed Acid for Phosphorus Flotation in the Concentrator

(3) Guizhou Kailin Mining and Fertilizer Co., Ltd.

- Implementation Plan for the Demonstration Project of Application of Advanced Purification Technology to Produce High-purity Wet Purification of Phosphoric Acid
- Project Proposal for 400,000 Tons (85% H_3PO_4) per Year PPA Project
- Environmental Impact Report for 400,000 Tons (85% H_3PO_4) per Year PPA Project
- Safety Condition Evaluation Report for 400,000 Tons (85% H_3PO_4) per Year PPA Project
- Energy Conservation Report for 400,000 Tons (85% H3PO4) per Year PPA Project

(4) Yunnan Phosphate Chemical Group Co., Ltd.

- Implementation Plan for Demonstration Project of Multipurpose Large-scale Processing and Utilization of Phosphate Chemical Wastes

(5) Xiangfeng Environmental Protection Technology Co., Ltd.

- Implementation Plan for Demonstration Project of Phosphogypsum Production of Composite Fillers Project
- Feasibility Study Report on Comprehensive Utilization Project of Phosphogypsum;
- Environmental Impact Statement for Comprehensive Utilization Project of Phosphogypsum
- Energy Conservation Report for Comprehensive Utilization Project of Phosphogypsum

(6) Zhonglicheng Industrial Co., Ltd.

- Implementation Plan for Demonstration Project of Recovery and Utilization of Yellow Phosphorus Tail Gas for Power Generation Project
- Feasibility Study Report on Technical Transformation Project for Environmental Protection, Energy Conservation, and Clean Production
- Environmental Impact Assessment Report for (Phase I) Technical Transformation Project for Environmental Protection, Energy Conservation, and Clean Production
- Safety Assessment Report for (Phase I) Technical Transformation Project for Environmental Protection, Energy Conservation, and Clean Production
- Energy Conservation Report for (Phase I) Technical Transformation Project for Environmental Protection, Energy Conservation, and Clean Production

Annex 2: PhosChemEE Project SESP

Part A. Integrating Programming Principles to Strengthen Social and Environmental Sustainability

QUESTION 1: How Does the Project Integrate the Programming Principles in Order to Strengthen Social and Environmental Sustainability?
Briefly describe in the space below how the project mainstreams the human rights-based approach
As in other UNDP-GEF projects, the PhosChemEE Project will be designed and implemented with a human-rights-based approach. 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. It is envisaged that, as in the discussions with partner provincial governments, during the project design, consultations will be carried out with the local communities in selected areas where the demonstrations showcase the applications of green utilization technologies. The project will create employment opportunities and reduce poverty among the local communities through potential phosphate mining with beneficiation technology applications, as well as an upgrade of the existing phosphate chemical industry and a new industry on the integrated processing of phosphate chemical byproducts such as phosphogypsum. The depletion of phosphogypsum stacks and reduction in phosphogypsum output in these regions will also reduce phosphogypsum-related pollutants' adverse impact on local water and soil quality, directly and indirectly contributing to the local agricultural production, food security, and public health. In the project development phase, local communities and enterprises will be involved in the consultation process on the demonstration project design and new industrial layout. Such consultations will be a continuous process even during project implementation to ensure that the project activities, particularly the demonstrations, seriously consider the welfare of indigenous peoples and all other residents of the communities. With full respect for the rights of local communities and according to UNDP Standard 6, an FPIC ("Free Prior Informed Consent") will be carried out and documented according to UNDP requirements at each demonstration site. This work will be a part of site-specific environmental and social ("E/S") assessments to be carried out for each demonstration on technology upgrading and solid waste utilization under the project. In the project implementation phase, professional training and education would be provided to local governments, enterprises, and employees of the phosphate chemical industry, and new employment opportunities would be offered in advance to indigenous communities. Additionally, a grievance redress mechanism would be established to ensure that access to work opportunities is equitable and that any adverse environmental and social effects of industrial activities be addressed promptly.
Briefly describe in the space below how the project is likely to improve gender equality and women's empowerment
The design of the proposed project will be guided by principles of gender equality and women's empowerment. Women are involved in both the management and technical departments of China's government agencies/institutions and play major roles in the top-level decision-making and strategic design process. On the ground level, the implementation of the proposed project will promote the welfare of and offer equal opportunities to both men and women, particularly women in underdeveloped regions. The design of the project activities will also consider further enhancing the role of women in the deployment of low-carbon technologies and climate change mitigation options and coming up with gender-sensitive policies in the resource sector and the downstream sectors of the country. Education and professional training would be provided, in particular to local employees, to improve women's professional competitiveness in the workplace and expand women's scope of employment in the underdeveloped and agriculture-based region. The detailed and confidential staff information database can be established based on big data analysis, which records both men's and women's information on

occupation, payment, etc. This will provide information on job mobility and welfare distribution in PCI enterprises following national gender-related laws and good international practices. Additionally, qualified and capable women consultants/experts will be targeted to work in the implementation of the designed project.

The implementation of this project will, first, improve the technical level and reduce the intensity of labor in the mining and beneficiation technology as well as the phosphate chemical industry, which will, in turn, improve women's work environment, job adaptability, and change of employment. Secondly, the implementation of this project will directly improve the quality of the local ecological environment and indirectly improve women's and children's health. Thirdly, implementation of this project will help ensure agriculture and food security through the reduction of rural pollution, and thus reduce the risk in women's major source of income in these regions.

Briefly describe in the space below how the project mainstreams sustainability and resilience

The central mission of this project is to promote systematic, sustainable transformation of China's phosphate mining and chemical industry. This will be pursued through major top-level strategies: strengthening of low-carbon policy guidance on the phosphate chemical industry, construction of a low-carbon demonstration system, establishment of low-carbon development standard system, development of technology and equipment in mining and beneficiation sector, along with solid waste comprehensive utilization, implementation of low-carbon phosphate chemical technologies promotion action, and popularization of low-carbon education. The strategic mechanisms would improve the utilization of phosphate resources and mining area environment, reduce the energy consumption in production, and promote waste utilization technology in the related areas; energy consumption and solid waste output reduction will be facilitated in the phosphate chemical industry during and after implementation of the proposed project. The promotion of clean and low-carbon processes and technologies within the whole life cycle of phosphate chemical production, the integrated utilization of phosphogypsum, and the phosphate mine tailing production of phosphate fertilizers are three focus areas of the project's carbon-emission reduction initiative. According to estimates, carbon emission reduction in phosphate mining can be at an average of 0.05 million tons of CO^2eq per year; the annual emission reduction in phosphate chemical production is about 1.19 million tons of CO^2eq, and the management of phosphate waste can reduce CO^2eq emissions of approximately 5.93 million tons per year (including 4.97 million tons in the integrated use of phosphogypsum to produce cement, and 0.96 million tons in phosphate mine tailing to produce phosphate-containing biological fertilizers). In total, the phosphate chemical industry can form a carbon dioxide emission reduction capacity of 7.39 million tons/year, or 36.97 million tons CO^2eq, during the five-year project implementation period. Most of China's phosphate mines and chemical production facilities are concentrated in Sichuan, Yunnan, Guizhou, Hubei, and other Yangtze River main streams and upstream tributary areas, resulting in severe pollution of water resources in the upper and middle reaches of the Yangtze River, the project's targeted implementation in the Yangtze Economic Belt would address not only environmental pollution and facilitate ecological repair but also enhance environmental resiliency of the underdeveloped communities through job creation and poverty reduction in these ecologically fragile areas.

Briefly describe in the space below how the project strengthens accountability to stakeholders

The project will be designed and implemented guided by principles of accountability. This would naturally ensure constant engagement with stakeholders in the design, implementation, and completion of the project. It is envisaged that the potential project-affected people will be informed of potential risks and UNDP's Accountability Mechanism during the project design and further strengthened in the implementation process. The demos will support meaningful participation and inclusion of all stakeholders, in particular marginalized individuals and groups, in processes that may impact them, including the design, implementation, and monitoring of the project. Provision of timely, accessible, and functional information regarding supported activities,

including potential environmental and social risks and impacts and management measures (SESP, ESMF), will be disclosed on UNDP China websites to ensure transparency of programming interventions. The Project Management Office (PMO) shall establish a project-level Grievance Redress Mechanism (GRM) during project inception. The full details of the GRM will be agreed upon during the project's inception phase. The Mechanism (SRM) ensures that individuals, people, and communities affected by projects have access to appropriate grievance resolution procedures for hearing and jointly addressing complaints and disputes related to the social and/or environmental impacts of the proposed projects. Interested stakeholders may raise a grievance at any time to the PMO, the Executing Agency, the Implementing Agency (UNDP), or the GEF. A monitoring and evaluation procedure is also designed to ensure effective monitoring-and where appropriate, participatory monitoring with stakeholders—and reporting on implementation of social and environmental risk management measures.

Part B. Identifying and Managing Social and Environmental Risks

QUESTION 2: What are the Potential Social and Environmental Risks? *Note: Complete SESP Attachment 1 before responding to Question 2.*	**QUESTION 3: What is the level of significance of the potential social and environmental risks?** *Note: Respond to Questions 4 and 5below before proceeding to Question 5*			**QUESTION 6: Describe the assessment and management measures for each risk rated Moderate, Substantial or High**
Risk Description (broken down by event, cause, impact)	***Impact and Likelihood (1-5)***	***Significance (Low, Moderate Substantial, High)***	***Comments (optional)***	***Description of assessment and management measures for risks rated as Moderate, Substantial or High***
The PhosChemEE Project (and most specifically Component 1, which focuses on the upstream Phosphate mining and refining sub-sector) could lead to adverse impacts on the enjoyment of the human rights (civil, political, economic, social, or cultural) of the affected population,	I = 5 L = 4	High	This project will be based in the underdeveloped western regions of Yunnan, Guizhou, Sichuan, and Hubei. Yunnan, Guizhou, Sichuan and Hubei have widespread minority cultures (that might	In the design stage, the following safeguards documents have been prepared, covering this risk and all other risks, to meet the SES requirements of a **High risk** project: · a stakeholder analysis and comprehensive Stakeholder Engagement Plan, · a gender analysis and Gender Action Plan, · an Environmental and Social Management

including ethnic minorities and vulnerable/disadvantaged groups. This is most likely to occur under Outputs 1.2.2, 2.2.2, and 3.2.2. Mining companies engaged in the project might not have the capacity and knowledge to uphold their duties as per UNDP SES requirements. This includes upholding duties and requirements on FPIC as per UNDP SES 6. *Human Rights: P.3, P.4, P.5* *Gender Equality: P.10:* *Accountability: P.13, P.14* *Standard 6: 6.1, 6.3, 6.4*			trigger SES Standard 6), but factories are mainly located in industrialized regions where cultural heritage is not concentrated. PCI industries do not geographically overlap with indigenous settlements, though impacts (positive or negative) on such communities cannot be ruled out at this early stage of project design.	Framework (ESMF) with initial FPIC procedures (to be applied if confirmed as required), · a Grievance Redress Mechanism (draft/outline). The ESMF outlines the procedures for the (site-specific) Environmental and Social Impact Assessments (ESIAs) and Environmental and Social Management Plans (ESMPs) that will assess impacts directly related to the sphere of influence of the demo sites. These will be prepared during project implementation. To adequately assess the impact of upstream/policy and strategy-level interventions (including potential cumulative impacts), the project shall undertake a Strategic Environmental and Social Assessment (SESA). The design and implementation of the project are consistent with the strategic requirements of the country's Law on ethnic unity and progress, which will ensure the enjoyment of the human rights of the potentially affected population in the demo places, especially ethnic minorities and/or vulnerable/disadvantaged groups. During the implementation of the project, extensive consultations will also be conducted with local people with the cooperation of the MIIT, MNR, and provincial government.
During the construction of demo activities (Output 2.2.2) and in support of the mining and refining sectors (under Component 1), potential adverse impacts to habitats	I = 4 L = 3	Substant ial	The demos (i.e. outputs 1.2.2, 2.2.2, 3.2.2) may generate construction waste during the construction of supporting facilities or new facilities and	The project has been designed such that demos will involve the conduct of a detailed feasibility study and ESIA on the local area before the demo site selection, and a site-specific ESMP will be put in place before the implementation of each demo.

and/or ecosystems and ecosystem services (e.g., non-hazardous waste from phosphogypsum reuse) may occur. *Standard 1: 1.1, 1.2., 1.3, 1.7, 1.11, 1.14* *Standard 8: 8.1, 8.2, 8.3, 8.6*			generate non-hazardous waste from phosphogypsum reuse. These may have an impact on the surrounding environment that includes ecologically fragile areas. The proposed interventions may not be effective at the start and will continue or may even further negatively impact the surrounding ambient environment, bodies of water or land areas in the project areas.	The demos will be designed and constructed in accordance with national and international standards to ensure compliance with the SES and other relevant environmental ordinances/regulations, as outlined in the ESMF (and to be in the forthcoming ESIA/ESMPs). Additionally, the Project will observe the established regulatory framework for monitoring and assessing such risks that are aligned with the SES. China has regulations on the engineering project site for the restoration and protection of biodiversity, and manufactories are not allowed to be established in or around ecosystem function zones. In this case, the PhosChemEE Project will ensure that the demo sites will be located far away from ecological reserves and ecologically vulnerable areas.
Inadequate disposal of waste during the operation of the phosphogypsum processing reuse demo (I.e. Outputs 3.2.1 and 3.2.2) poses a threat to the environment as well as the health and safety of workers and the community. The associated construction, operation, or decommissioning of the demo installations may pose potential health and safety risks to local communities and workers due to the transport, storage, and use and/or disposal of any hazardous or dangerous materials (e.g. explosives,	I = 4 L = 3	Substant ial	Specifically, if fluorine and arsenic contained in phosphogypsum are released into the atmosphere and soil environment, they will have adverse effects on surface/underground water plants and animals and produce health risks to local communities.	The ESMF and subsequent ESIA and ESMP will address all health and safety risks. The required management measures will be included in site-specific ESMPs and be conducted before project construction. Per those forthcoming plans, appropriate training will be provided to the demonstration enterprises to ensure that risks are properly addressed and managed. Training will also be provided to local governments in order to enhance their regulation capacity and control potential risks during the demonstration. A Grievance Mechanism will be designed (see ESMF) and will be implemented by the project, allowing communities and workers to request interventions when facing issues with health and safety risks.

fuel, and other chemicals) that may be used during construction and operation. *Standard 1: 1.1, 1.2., 1.3, 1.7, 1.11, 1.14* *Standard 3: 3.1, 3.2, 3.5, 3.6, 3.7* *Standard 4: 4.2, 4.3* *Standard 6: 6.1, 6.3* *Standard 7: 7.1, 7.5, 7.6* *Standard 8: 8.1, 8.2, 8.3, 8.6*				The associated construction, operation, or decommissioning of the demo installations will strictly comply with the national standards and international general standards on construction and waste management, as noted in the ESMF. Site-specific environmental and social assessments will be conducted for each demo to identify the critical health and safety risks. Where public access is available, appropriate engineering and administrative controls (e.g., detours, traffic calming, signs) will be considered and implemented in advance during the construction and operation of demos. All contractors (i.e., undertaken engineering and infrastructure works as part of the project) will be required to develop, submit and adhere to a Labour Management Plan that meets the requirements of both UNDP SES 7 and relevant national/host country law and regulation. Appropriate training will be provided to workers to ensure that they install and operate the installed system correctly and safely, and properly control and manage the release or disposal of waste. Training will also be provided to local governments in order to enhance their regulation capacity to control potential risks in the demonstration. This will minimize or avoid any community health risks and safety issues for the communities regarding construction work involved in the installation of the demos, and the minimization and management of waste generated from these demos (e.g., explosives, fuel and other chemicals).

The potential outcomes of the PhosChemEE Project will be sensitive or vulnerable to the potential impacts of climate change. Yunnan, Sichuan, Guizhou, and Hubei, where the demos are located, have risks of extreme weather that are exacerbated by climate change. Thus, some of the demonstration activities of the project (located outdoors) can be impacted by weather events. *Standard 2: 2.2, 2.3, 2.4* *Standard 3: 3.1*	I = 3 L = 3	Moderate	Some that are sheltered may also be impacted by such climate change-aggravated weather events that can cause extreme heat during summers or maybe flooding during rainy seasons.	The ESIAs (as required and outlined in the ESMF) will assess activities for impact and sustainability within China national context, including its climatic vulnerability and associated impacts. The design of the demo will take climate-related events and risks into consideration by utilizing the findings of the risk assessment that shall be conducted as part of the ESIAs. environment risk assessment. Appropriate measures will be taken based on the specific climate-related events. For instance, the adverse impact of the flood on demos can be eliminated by constructing diversion ditches, while sunshade roofs and cooling spray can reduce the impact of extremely high temperatures. The demos will also cover climate risk adaptation capacity building through training workshops (Activities 1.2.2.3, 2.2.2.2, 3.2.2.3). This training will be provided to demo companies and local governments to enhance their capacity to deal with extreme climate events in general. Depending on the extent of the impacts of the adverse climate-related events, appropriate modifications to the installations (and budget) will be made. Potential reduction in the number of installations or replacement with alternative demos will be done while considering the need to ensure the resulting interventions are still contributing to the realization of the project outcomes.
The Project includes activities both downstream/physical activities (like	I = 4 L = 3	Substantial	Phosphate chemicals production, as well as	Per the ESMF, the ESIA and ESMP will define the management measures for this risk. In the design of

phosphogypsum processing), as well as upstream/policy-level interventions that require/could lead to significant consumption of raw materials, energy, and/or water and involve significant extraction, diversion, or containment of surface and/or groundwater. That resource use, if not designed or implemented well, could lead to adverse impacts on ambient conditions in the project area and area of influence. *Standard 1: 1.1, 1.2., 1.3, 1.7, 1.11, 1.14* *Standard 8: 8.1, 8.2, 8.3, 8.6*			phosphogypsum processing consume significant amounts of water. Existing processes are energy inefficient, have considerable material losses and wastewater generation. While the project will promote cleaner and more energy-efficient phosphate chemicals production and processing of phosphogypsum that will either reduce or optimize the use of water, more processing of phosphogypsum may increase the water demand, and depending on where water is sourced, can result in significant extraction, diversion or containment of surface and/or groundwater.	demos, life-cycle analysis (LCA) will be conducted before each industrial process to assess the raw materials, energy, and water used in new technologies and evaluate the potential of resource conservation. Based on LCA assessments, the project will be designed to seek cleaner and more energy-efficient phosphate chemicals production and processing of phosphogypsum. International practice for water and energy conservation will be applied in demos, especially the wastewater management and reuse technologies. Emergency accident pools will be designed in each demo in accordance with the requirement of contamination avoidance. Additionally, the demos will establish the resource efficiency monitoring mechanism, including using benchmarking data to the relative level of efficiency and reporting water and energy consumption periodically. This will ensure that the new and advanced technologies of phosphate chemicals production and phosphogypsum processing will reduce or optimize resource consumption so that the project's water consumption does not have significant adverse impacts on communities, other users, or the environment and ecosystems. The potential for cumulative impacts relating to water and energy consumption will also be assessed in the project's SESA.
The PhosChemEE Project results in significant greenhouse gas emissions or may exacerbate climate change due to massive energy consumption in phosrock mining and refining and	I = 4 L = 3	Substant ial	Improving the efficiency of energy usage in phosrock mining and refining and in phosphate chemicals production will reduce energy	As per the project's ESMF, this risk area will be included within the scope of the ESIAs/ESMPs (for demo site-related impacts) and the project's SESA for upstream and cumulative STnadard2-related impacts.

in phosphate chemicals production. *Standard 2: 2.3, 2.4* *Standard 8: 8.6*			consumption and reduce GHG emissions. Increased processing of phosphogypsum can be made energy efficient but will make use of extra energy that will bring about extra GHG emissions (unless the energy source is renewable).	The LCA method will be conducted before project construction during the design of the demonstrations to identify potential project-related increases in GHG emissions that may exacerbate climate change. Then, the potential sources of emissions related to project activities will be estimated to form a baseline for developing measures to reduce such emissions. The PhosChemEE Project aims to enable the extensive application of low-carbon and energy-efficient technologies in the phosphate chemicals industry in China. To mitigate the potential increment of GHG emissions, the demos will apply these three solutions. First, the demos will promote new, advanced, and energy-efficient technologies, which will directly reduce emissions in phosphate ore processing and phosphorus chemical production. Second, Yunnan, Guizhou, Sichuan and Hubei, where the demo sites are located, are rich in renewable energy resources. This will offset the potential extra GHG emissions from the overconsumption of energy induced by the new technologies. Lastly, most of the demos will follow the principle of circular economy, including avoiding waste discharge and promoting the recycling and reusing of waste. Such measures will reduce the indirect emissions from intermediate material production and waste management. Additionally, GHG emissions of demos will be tracked and reported in accordance with provisions of the UNFCCC, and GHG minimization measures are implemented.

Upstream project activities (primarily Outputs 1.1.1, 1.1.2, 2.1.1, 2.1.2,, 2.1.6, 2.2.4, 2.2.5, 3.1.1, and 3.1.2,) could result in adverse impacts to the local communities and the receptor environment if project-supported policy initiatives are not adequately screened and assessed. China accounts for more than 80% of the world's total production capacity of Phosphate. As such, the project could inadvertently lead to issues of global and/or cumulative environmental concern if not managed adequately. *All SES Principles and Standards*	I-5 L-3	Substant ial	Given the scope of the project, upstream activities are likely to have SES-related impacts associated with them. In addition, China's position as the main source of Phosphate production and potential SES-impacts could result in issues of global/cumulative concern.	The project will undertake the conduct of an SESA that shall cover all upstream activities and those with potential cumulative impact-related implications. Activities that will fall under the scope of the SESA include (but are not limited to): Outputs 1.1.1, 1.1.2, 2.1.1, 2.1.2 , 2.1.6, 2.2.4, 2.2.5, 3.1.1, and 3.1.2,)
8. The phosphogypsum processing and reuse demos have been planned to be implemented in the existing facility. Legacy pollution issues may exist that have ongoing environmental impacts, which will have to be managed in line with UNDP SES requirements. *Standard 8: 8.1, 8.2, 8.3, 8.6*	I-4 L-2	Moderat e	The phosphogypsum processing and reuse demo is mainly implemented in the existing facility. However	The site-specific ESIAs will include an assessment of historical pollution/legacy issues at demo sites that are being planned for existing facilities. Any historical/legacy pollution issues that are deemed to have ongoing environmental concerns will be remediated and managed within the framework of the site-specific ESMPs that are to be developed as well.
9. There is the possibility that through some possible changes to the use of lands and resources in the phosphogypsum processing and reuse demo outputs of the project, access restrictions/economic displacement may occur as a result of indirect	I-4 L-2	Moderat e	The project may indirectly lead to changes in land use/tenure status for affected populations.	Any access restrictions/economic displacement-related issues are likely to occur only as an indirect result of project-supported activities. However, SES5 related impacts cannot be ruled out at this stage of the project preparation. SES5 related risks will be assessed in detail at both

impacts emanating from the project's interventions. *Standard 5: 5.4*				a demonstration level (via the conduct of site-specific ESIAs) and at a policy/upstream level (through the conduct of the project's SESA). Any impacts identified shall be managed through the relevant avenues. IF adverse SES5 related impacts are identified, then necessary SES tools may be required to be undertaken (this could include a Livelihood Action Plan, Land Acquisition Action Plan etc.).		
	QUESTION 4: What is the overall project risk categorization?					
	Low Risk	☐				
	Moderate Risk	☐				
	Substantial Risk	☐				
	High Risk	√		The overall risk is High. An ESMF has been prepared during the PPG stage to ensure that the necessary steps are taken to assess and manage both (i) the site-specific risks during implementation (during which site-specific assessments and management plans will be required) and (ii) upstream/policy-level interventions that may result in adverse impacts (including cumulative impacts) through the conduct of a SESA.		
	QUESTION 5: Based on the identified risks and risk categorization, what requirements of the SES are triggered? (check all that apply)					
	Question only required for Moderate, Substantial and High Risk projects					
	Is assessment required? (check if "yes")	√				***Status? (completed, planned)***

	if yes, indicate overall type and status		√	Targeted assessment(s)	Completed: stakeholder analysis, gender analysis Planned: LCA
			√	ESIA (Environmental and Social Impact Assessment)	Site specific ESIAs (Planned)
			√	SESA (Strategic Environmental and Social Assessment)	Planned
	Are management plans required? (check if "yes)	√			
	If yes, indicate overall type		√	Targeted management plans (e.g. Gender Action Plan, Emergency Response Plan, Waste Management Plan, others)	Completed: Gender Action Plan, Stakeholder Engagement Plan has been completed Planned: Labor Management Plans
			√	ESMP (Environmental and Social Management Plan which may include range of targeted plans)	Site specific ESM (Planned)

			√	ESMF (Environmental and Social Management Framework)	Completed
	Based on identified <u>risks</u>, which Principles/Project-level Standards triggered?		**Comments (not required)**		
	Overarching Principle: Leave No One Behind				
	Human Rights	√	Risk 1		
	Gender Equality and Women's Empowerment	√	Risk 1		
	Accountability	√	Risk 1		
	1. Biodiversity Conservation and Sustainable Natural Resource Management	√	Risk 2 Risk 3 Risk 5 Risk 7		
	2. Climate Change and Disaster Risks	√	Risk 4 Risk 6 Risk 7		
	3. Community Health, Safety and Security	√	Risk 4 Risk 4 Risk 7		
	4. Cultural Heritage	√	Risk 1 Risk 7		
	5. Displacement and Resettlement	√	Risk 7 Risk 9		
	6. Indigenous Peoples	√	Risk 1 Risk 3 Risk 7		
	7. Labour and Working Conditions	√	Risk 3 Risk 7		
	8. Pollution Prevention and Resource Efficiency	√	Risk 2 Risk 3 Risk 5 Risk 6		

			Risk 7 Risk 8

Annex 3：SESP Social and Environmental Risk Screening Checklist

Overarching Principle: Leave No One Behind **Human Rights**	**Answer (Yes/No)**
P.1 Have local communities or individuals raised human rights concerns regarding the project (e.g. during the stakeholder engagement process, grievance processes, public statements)?	No
P.2 Is there a risk that duty-bearers (e.g. government agencies) do not have the capacity to meet their obligations in the project?	No
P.3 Is there a risk that rights-holders (e.g. project-affected persons) do not have the capacity to claim their rights?	Yes
Would the project potentially involve or lead to:	
P.4 Adverse impacts on the enjoyment of the human rights (civil, political, economic, social, or cultural) of the affected population and particularly of marginalized groups?	Yes
P.5 inequitable or discriminatory impacts on affected populations, particularly people living in poverty or marginalized or excluded individuals or groups, including persons with disabilities?	Yes
P.6 Restrictions in availability, quality of, and/or access to resources or basic services, in particular to marginalized individuals or groups, including persons with disabilities?	No
P.7 Exacerbation of conflicts among and/or the risk of violence to project-affected communities and individuals?	No
Gender Equality and Women's Empowerment	
P.8 Have women's groups/leaders raised gender equality concerns regarding the project, (e.g. during the stakeholder engagement process, grievance processes, public statements)?	No
Would the project potentially involve or lead to:	
P.9 Adverse impacts on gender equality and/or the situation of women and girls?	No
P.10Reproducing discrimination against women based on gender, especially regarding participation in the design and implementation of access to opportunities and benefits?	Yes
P.11limitations on women's ability to use, develop, and protect natural resources, taking into account different roles and positions of women and men in accessing environmental goods and services? For example, activities that could lead to natural resource degradation or depletion in communities that depend on these resources for their livelihoods and well-being	No
P.12exacerbation of risks of gender-based violence? For example, through the influx of workers to a community, changes in community and household power dynamics, increased exposure to unsafe public places and/or transport, etc.	No
Sustainability and Resilience: Screening questions regarding risks associated with sustainability and resilience are encompassed by the Standard-specific questions below	
Accountability	
Would the project potentially involve or lead to:	
P.13 Exclusion of any potentially affected stakeholders, in particular, marginalized groups and excluded individuals (including persons with disabilities), from fully participating in decisions that may affect them?	Yes
P.14 Grievances or objections from potentially affected stakeholders?	Yes
P.15 Risks of retaliation or reprisals against stakeholders who express concerns or grievances or who seek to participate in or to obtain information on the project?	No
Project-Level Standards	
Standard 1: Biodiversity Conservation and Sustainable Natural **Resource**	

Management	
Would the project potentially involve or lead to:	
1.1 adverse impacts to habitats (e.g. modified, natural, and critical habitats) and/or ecosystems and ecosystem services? For example, through habitat loss, conversion or degradation, fragmentation, hydrological changes	Yes
1.2 activities within or adjacent to critical habitats and/or environmentally sensitive areas, including (but not limited to) legally protected areas (e.g. nature reserve, national park), areas proposed for protection, or recognized as such by authoritative sources and/or indigenous peoples or local communities?	Yes
1.3 changes to the use of lands and resources that may have adverse impacts on habitats, ecosystems, and/or livelihoods? (Note: if restrictions and/or limitations of access to lands would apply, refer to Standard 5)	Yes
1.4 risks to endangered species (e.g. reduction, encroachment on habitat)?	No
1.5 exacerbation of illegal wildlife trade?	No
1.6 introduction of invasive alien species?	No
1.7 adverse impacts on soils?	Yes
1.8 harvesting of natural forests, plantation development, or reforestation?	No
1.9 significant agricultural production?	No
1.10 animal husbandry or harvesting of fish populations or other aquatic species?	No
1.11 significant extraction, diversion, or containment of surface or ground water? For example, construction of dams, reservoirs, river basin developments, groundwater extraction	Yes
1.12 handling or utilization of genetically modified organisms/living modified organisms?	No
1.13 utilization of genetic resources? (e.g. collection and/or harvesting, commercial development)	No
1.14 adverse transboundary or global environmental concerns?	Yes
Standard 2: Climate Change and Disaster Risks	
Would the project potentially involve or lead to:	
2.1 areas subject to hazards such as earthquakes, floods, landslides, severe winds, storm surges, tsunamis or volcanic eruptions?	No
2.2 outputs and outcomes sensitive or vulnerable to potential impacts of climate change or disasters? For example, through increased precipitation, drought, temperature, salinity, extreme events, earthquakes	Yes
2.3 increases in vulnerability to climate change impacts or disaster risks now or in the future (also known as maladaptive or negative coping practices)? For example, changes to land use planning may encourage further development of floodplains, potentially increasing the population's vulnerability to climate change, specifically flooding	Yes
2.4 increases of greenhouse gas emissions, black carbon emissions, or other drivers of climate change?	Yes
Standard 3: Community Health, Safety and Security	
Would the project potentially involve or lead to:	
3.1 construction and/or infrastructure development (e.g. roads, buildings, dams)? (Note: the GEF does not finance projects that would involve the construction or rehabilitation of large or complex dams)	Yes
3.2 air pollution, noise, vibration, traffic, injuries, physical hazards, poor surface water quality due to runoff, erosion, sanitation?	Yes
3.3 harm or losses due to failure of structural elements of the project (e.g. collapse of buildings or infrastructure)?	No

3.4 risks of water-borne or other vector-borne diseases (e.g. temporary breeding habitats), communicable and noncommunicable diseases, nutritional disorders, mental health?	No
3.5 transport, storage, and use and/or disposal of hazardous or dangerous materials (e.g. explosives, fuel and other chemicals during construction and operation)?	Yes
3.6 adverse impacts on ecosystems and ecosystem services relevant to communities' health (e.g. food, surface water purification, natural buffers from flooding)?	Yes
3.7 influx of project workers to project areas?	Yes
3.8 engagement of security personnel to protect facilities and property or to support project activities?	No
Standard 4: Cultural Heritage	
Would the project potentially involve or lead to:	
4.1 activities adjacent to or within a Cultural Heritage site?	No
4.2 significant excavations, demolitions, movement of earth, flooding, or other environmental changes?	Yes
4.3 adverse impacts on sites, structures, or objects with historical, cultural, artistic, traditional, or religious values or intangible forms of culture (e.g. knowledge, innovations, practices)? (Note: projects intended to protect and conserve Cultural Heritage may also have inadvertent adverse impacts)	Yes
4.4 alterations to landscapes and natural features with cultural significance?	No
4.5 utilization of tangible and/or intangible forms (e.g. practices, traditional knowledge) of Cultural Heritage for commercial or other purposes?	No
Standard 5: Displacement and Resettlement	
Would the project potentially involve or lead to:	
5.1 temporary or permanent and full or partial physical displacement (including people without legally recognizable claims to land)?	No
5.2 economic displacement (e.g. loss of assets or access to resources due to land acquisition or access restrictions – even in the absence of physical relocation)?	No
5.3 risk of forced evictions?	
5.4 impacts on or changes to land tenure arrangements and/or community based property rights/customary rights to land, territories and/or resources?	Yes
Standard 6: Indigenous Peoples	
Would the project potentially involve or lead to:	
6.1 areas where indigenous peoples are present (including project area of influence)?	Yes
6.2 activities located on lands and territories claimed by indigenous peoples?	No
6.3 impacts (positive or negative) on the human rights, lands, natural resources, territories, and traditional livelihoods of indigenous peoples (regardless of whether indigenous peoples possess the legal titles to such areas, whether the project is located within or outside of the lands and territories inhabited by the affected peoples, or whether the indigenous peoples are recognized as indigenous peoples by the country in question)? If the answer to screening question 6.3 is "yes," then the potential risk impacts are considered significant, and the project would be categorized as either Substantial Risk or High Risk	Yes
6.4 the absence of culturally appropriate consultations carried out with the objective of achieving FPIC on matters that may affect the rights and interests, lands, resources, territories, and traditional livelihoods of the indigenous peoples concerned?	Yes
6.5 the utilization and/or commercial development of natural resources on lands and territories claimed by indigenous peoples?	No
6.6 forced eviction or the whole or partial physical or economic displacement of indigenous peoples, including through access restrictions to lands, territories, and resources?	No

Consider, and where appropriate, ensure consistency with the answers under Standard 5 above	
6.7 adverse impacts on the development priorities of indigenous peoples as defined by them?	No
6.8 risks to the physical and cultural survival of indigenous peoples?	No
6.9 impacts on the Cultural Heritage of indigenous peoples, including through the commercialization or use of their traditional knowledge and practices? Consider, and where appropriate, ensure consistency with the answers under Standard 4 above.	No
Standard 7: Labour and Working Conditions	
Would the project potentially involve or lead to: (note: applies to project and contractor workers)	
7.1 working conditions that do not meet national labour laws and international commitments?	Yes
7.2 working conditions that may deny freedom of association and collective bargaining?	No
7.3 use of child labour?	No
7.4 use of forced labour?	No
7.5 discriminatory working conditions and/or lack of equal opportunity?	Yes
7.6 occupational health and safety risks due to physical, chemical, biological, and psychosocial hazards (including violence and harassment) throughout the project life-cycle?	Yes
Standard 8: Pollution Prevention and Resource Efficiency	
Would the project potentially involve or lead to:	
8.1 the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional, and/or transboundary impacts?	Yes
8.2 the generation of waste (both hazardous and non-hazardous)?	Yes
8.3 the manufacture, trade, release, and/or use of hazardous materials and/or chemicals?	Yes
8.4 the use of chemicals or materials subject to international bans or phase-outs? For example, DDT, PCBs, and other chemicals listed in international conventions such as the Montreal Protocol, Minamata Convention, Basel Convention, Rotterdam Convention, Stockholm Convention	No
8.5 the application of pesticides that may have a negative effect on the environment or human health?	No
8.6 significant consumption of raw materials, energy, and/or water?	Yes