Sahiwal Coal Power Plant

An Early Harvest Project of CPEC

"Exploring Employment and Environmental Effects"

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OVERVIEW

This case study attempts to describe the significance of energy-generating plants in Pakistan which are not solely focused on the provision of electricity, but also identifies the inducement of viable, long-term job growth in the regions they operate in. Two primary concerns among the general public remain both the environmental and employment ramifications of initiatives constituting under CPEC such as the Sahiwal Coal Power Project. The data in this particular report has been parsed and cultivated via questionnaire responded by the officials at various relevant administrative tiers of the project in Sahiwal. Initial findings indicate creation of a viable 8,500 direct jobs in both the constructional and operational phase of the coal plant. Additional specifications allow us to ascertain that the Sahiwal plant operates on super-critical coal emission platform, which is promising to decrease the amount of carbon dioxide pollutants throughout the Punjab.

INDUSTRIALIZATION AND PROSPERITY

The prosperity and welfare of the modern nation-state is unconditionally reliant on the scale of industrialization. When attempting to fully automate and innovate in a variety of economic sectors via basic capitalist means, developing countries often find themselves at the mercy of unwanted phenomena such as pollution, hazardous machinery, unsafe working environments, career insecurity, and non-liveable wages. Whereas ideal management of such economic repercussions is yet to be found, the “invisible hand” theory as proposed by Adam Smith provides a platform by which the interests of both those in command of capital and the general consumer happen to overlap with one another, thereby creating an environment where commerce thrives. In light of such a mechanism, nation-states who succeed to transform reap the benefit of their status as developed, which subsequently leads to increased levels of wealth generation. However, when certain industrial niches are forced to overcome specific flaws in their region’s political economy (whether they be poor regulation, vague compliance policies, or a lack of energy and mineral resources) the prerequisites for growth quadruple.

"The Industrial Revolution has two phases: one material, the other social; one concerning the making of things, the other concerning the making of men"

Charles A. Beard

BOTTLE NECK OF PAKISTAN AND CPEC

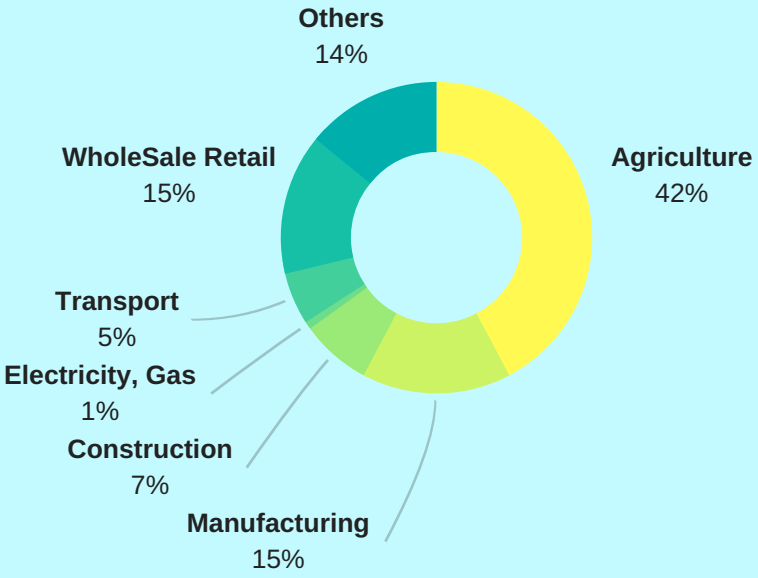
The accumulation of massive shortfalls in electricity generation and transmission has hampered basic industrial activity in Pakistan for a period close to a decade. Crucial manufacturing industries, such as textile, have found their capital fleeing to nearby regions where guaranteed power supplies are a norm.

An estimated one-hundred-forty-four million Pakistani citizens are deprived of full, uninterrupted access to electricity, and a subsection of sixty-nine million individuals from said group lack access to the national grid system. A further seventy-five million may have their communities wired to normal, public grid chains but remain unable to fully utilize it due to shortfalls, circular debt, and faulty transmission.

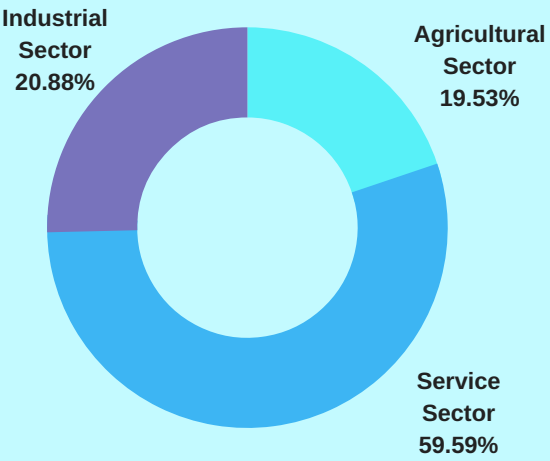
After having connection of only 12 hours on average, 22 million households end up spending around US$ 23 billion in alternative sources to fulfill their needs. Still inadequate and deficient lightning products restrict their productivity.

Meanwhile, seventy-percent of the labour force continues to toil in the agricultural sector, albeit the niche only contributes a mere nineteen-percent to Pakistan's overall Gross Domestic Product (GDP). Services, which continue to grow on an annual basis in regards to its share of GDP [currently at fifty-four-percent for the fiscal year] make up a third of total employment in Pakistan. The federal government of Pakistan has continued to adopt strategies designed to mitigate both the shortfall of energy within its borders as well as the provision of employment for an ever-growing demographic bulk of youth under the age of thirty - albeit with little result. Under such a resource-stressed economy, the China-Pakistan Economic Corridor (CPEC) provides a platform by which rapid infrastructure development allows for further industrialization.

A mammoth proportion of investment under CPEC comprises of massive upgrades to Pakistan's energy and shipping infrastructure. Furthermore, the groundwork for the allocation of an upwards of nine Special Economic Zones (SEZs) is being laid for the purpose of employment generation, foreign investment inflow, and the development of export-oriented production. Early-harvest energy projects include the now-operational Sahiwal Coal Power Plant.



Employment Share of Major Sectors



GDP Share of Three Major Sectors

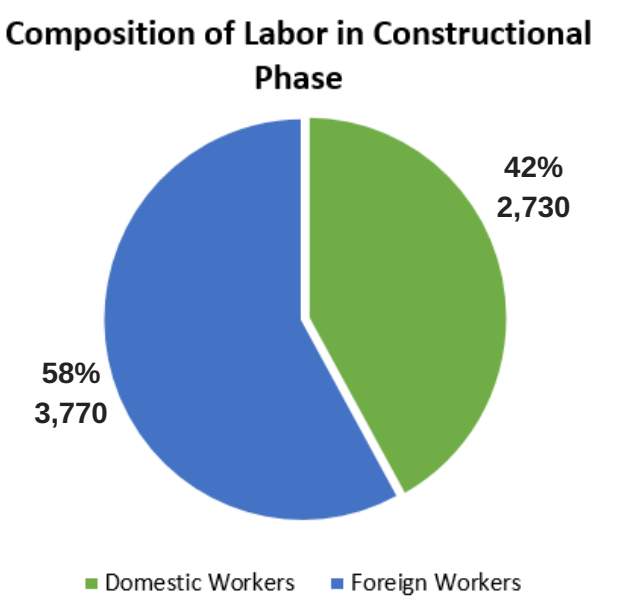
42 percent of the workforce of Pakistan is employed in the agricultural sector which only contributes 19.53 percent in the GDP of Pakistan. While, employing only one-third of the total employment, the service sector contributes 59.9 percent in the GDP.

SAHIWAL COAL POWER PLANT

Sahiwal is an urban center in the province of Punjab that enjoys a considerable population of 2,517,560 citizens as well as 3201 square kilometers of area amidst considerable connectivity to several rail and road routes to industrial centres in Punjab and Sindh. The Sahiwal Coal Power Plant project under CPEC was initiated by both Huaneng Shandong and Shandong Ruyi Technology Group Ltd., with both having a share of fifty-percent each. Responsibility for all operations, however, only lies with Huaneng Shandong. The project in itself lies twelve miles from the main core of Sahiwal, with an initial investment of PKR 1.44 billion. Ground-breaking began in the late summer of 2015, with the total length of time for construction equating to twenty-two months. The plant was completed twenty-two days ahead of management's own internal target, and two-hundred days prior to the expiration of the federal/provincial tender contract.

The project's total production capacity is 2x660 MW which employs super-critical coal-burning technology is considered to be the first sort of facility of its kind in Pakistan. Electricity produced in Sahiwal is further transmitted to the national grid, with an annual delivery of nine billion KWH of electricity which may meet the demand of an upwards of ten million households. It is further expected to correct one-quarter of the overall electricity shortfall in Pakistan. After an analysis of the socioeconomic ramifications of such infrastructure, the conclusion of power plants inducing abundant employment and further raising incomes is lent credence.

EMPLOYMENT GENERATION UNDER SAHIWAL COAL POWER PLANT PROJECT

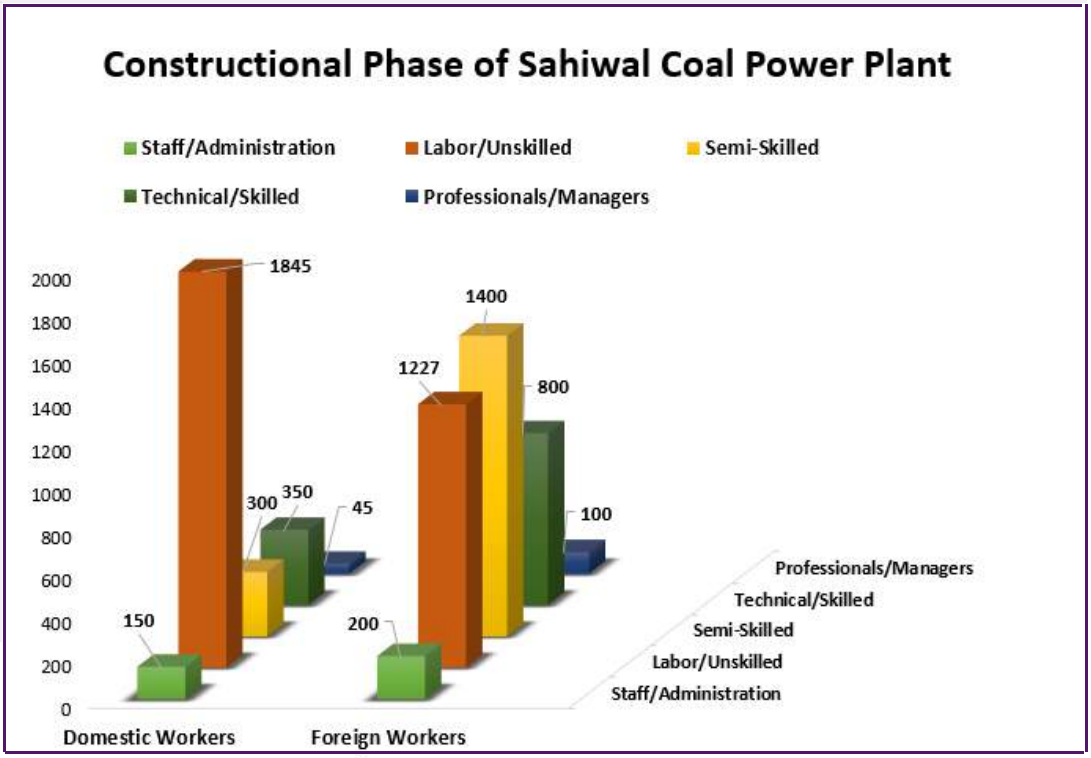


Considering the various economic fissures prevailing in Pakistan as discussed earlier, (i.e inequitable underdevelopment, low energy access, low human capital, and accompanying low productivity) - the Sahiwal plant, having been operational from October 2017 onwards, has performed commendably in raising overall employment throughout the Okara, Pakpattan, and Sahiwal districts. In doing so, the overall socioeconomic demographic of a few thousand families has been raised, while labourers enjoy on-site training by both local and international professionals that far surpasses the sort they'd receive while employed with other projects. Induced employment is accompanied by a mammoth 1320MW of generated electricity to add to a national grid that is already undergoing capacity and transmission upgrades.

Jobs Created under Constructional Phase

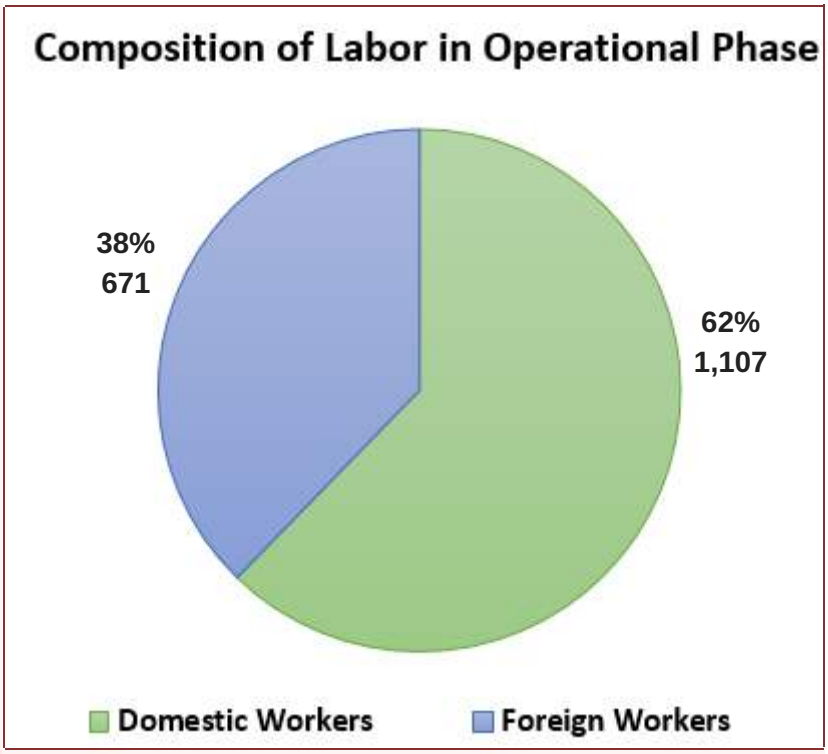
A questionnaire was developed in order to ascertain the specific career tiers at the Sahiwal facility, as well as the basic material provisions for staff on the site. The amount of direct jobs generated during the constructional phase of the plant numbers at 6,500, of which 2730 (42%) were domestic and 3770 (58%) were foreign, mainly from the People's Republic of China. In regards to administrative occupational groups, the amount of white-collar Pakistani professionals in managerial posts with at least five years of relevant experience numbered at 45 (31%) while an additional 100 (69%) were sourced from China. In regards to technical and skilled labour, 350 (30%) came from domestic Pakistani sources while 800 (70%) were foreign (Chinese) in nature. Additionally, 300 (17.64%) semiskilled, 1,845 (60%) unskilled, and 150 (43%) administrative staff were all procured locally from Pakistan during the overall culmination of the Sahiwal plant's constructional phase. Such figures give an impression of foreign human resources outnumbering basic domestic labour.

The primary exigence of such an unbalance worker composition mainly lies in the unavailability of specific skillsets amongst domestic labour, with such gaps being filled by the importation of Chinese labour resources, which are accompanied by higher operating costs in regards to wages, insurance, hazard pay, and travel accommodations.



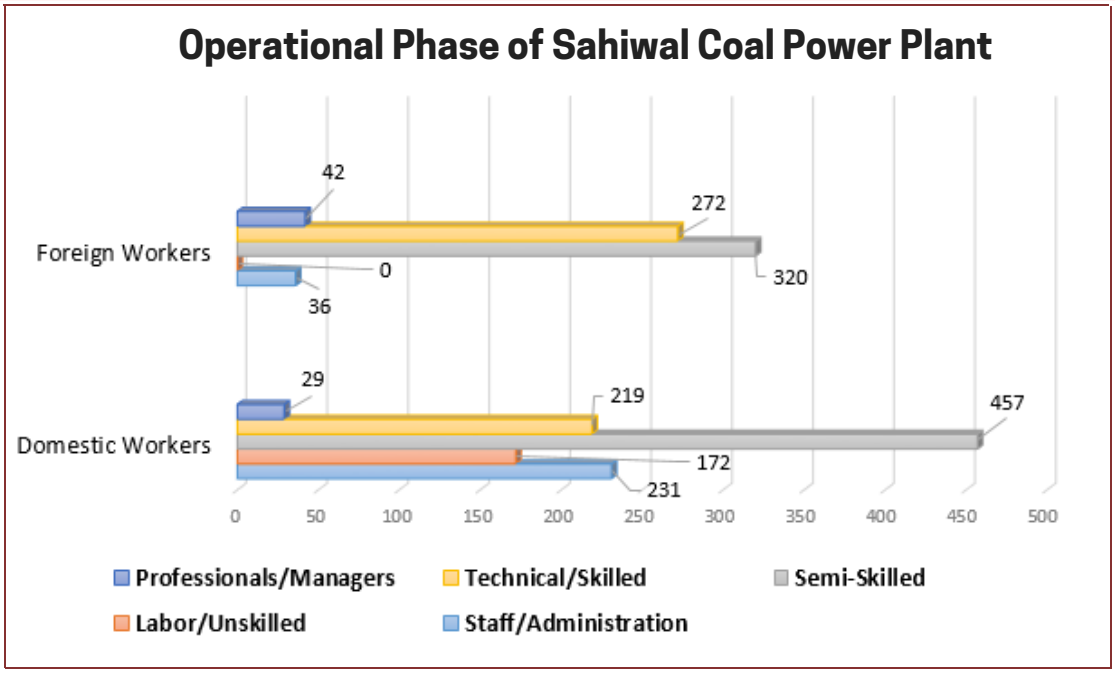
Jobs Created under Operational Phase

Moving on towards the operational phase, the total amount of direct jobs created under this phase are 1,778, from which 1,107 (62%) are the domestic labourers while 671 (38%) are foreigners. As the plant is based on super-critical coal technology, the prevailing engineering graduate skill-set was insufficient to meet the requirements for technical personnel. As a result, Chinese administrators began by being focused on the employment of graduates from specific universities in Pakistan. The first batch was completely hired from the University of Engineering and Technology Lahore (UET) and the National University of Sciences and Technology (NUST) Islamabad. The graduates hired from UET numbered 80 to 90 out of 124 engineers, while the rest were from NUST.



However the next recruitment cycle in 2016 was derived from almost all accredited engineering f in Pakistan. The employees, soon after recruitment, are sent to China for 6 months for technical training and later on sent to the University of Engineering and Technology Lahore to complete a 12-module program specifically designed for the operational phase of the Sahiwal plant. All of these candidates returned by August 2017. Currently, foreign workers are mostly employed in the maintenance department and have an exit window from the Pakistani labour market of three years. In this regard, around 100 domestic labourers have been hired in the previous year (2017) in the maintenance department, whereas, with a hundred more expected for the next fiscal year.

After taking into account the five major occupational groups, 29 (40 percent) individuals have been hired on professional and managerial posts, domestically, while the remaining 42 (60 percent) from abroad, summing up a total of 71 executive managers. While the technical labourers hired domestically are 219 (44 percent) in contrast to 272 (66 percent) as foreigners. Similarly, 457 (59 percent) semiskilled, 172 (100 percent) unskilled and 231 (86 percent) administrative staff have been hired from Pakistan for the purpose of the operational phase of the plant. This information has been presented into the following figure which clarifies the whole picture.



Along with the job creation, certain steps have been taken to intensify the job standards within the premises, with the help of which, both domestic and foreign labourers are entertained. This includes an eating area with free lunches, medical facilities, appropriate ventilation and climate control, safety training, in-house trainings, and paid leave.

Domestic and international-tier training as well as workshop seminars are organized, job promotions are fairly awarded without nationality-based biasness or discrimination, hence, administrative talent is developed from within the plant. One thing which is pertinent to note here is that, above analysis focuses on the direct jobs created under this project. While the plant has further sub-contractors which are required to accomplish other tasks of the firm, including security, coal intake from the railways till the coal mill etc. which creates indirect jobs. These companies include but are not limited to; PANDA, PANDA HR, SEPCO, TEPC, HENAN, LAUNCH, GREEN JIN CHINA and BEJING CHINA.

In order to produce 1320MW of electricity, almost 11 thousand tons of coal is consumed by the plant on a daily basis. This coal is delivered by 5 trains, each carrying around 40 wagons, and each wagon has a capacity to retain 60 tons of coal. The rent paid to Pakistan Railways for one wagon varies from 70 to 90 thousand rupees, generating extensive revenues for the government. The coal yard of the plant is designed to store 376 thousand tons of coal which is enough to operate the plant for more than a month. The plant possesses another coal yard which is located in Karachi, and has the capacity to store 250 thousand tons of coal.

Along with Job creation various facilities are being provided by the plant.
11,000 tons of coal is utilized to produce the required electricity. This coal is delivered by 5 trains each caring 40 wagons
The plant can store almost 376 thousand of coal as reserve enough for a month

SAHIWAL COAL POWER PLANT AND ENVIRONMENT

Currently, coal fired power plants are generating 41% of global electricity (World Coal Association). Sahiwal Power Plant is Pakistan's first super-critical coal-fired power plant, which consists of 2x660MW generators having a combined capacity of 1320 megawatts. These technically-advanced plants operate above the critical condition, (the state of a substance beyond which there is no distinction between liquid and gaseous phase) which offers greater efficiency than older sub-critical designs and, most importantly, lower emissions. Efficiency of a typical sub-critical power plant is 38%, whereas today's super-critical technology may increase this to around 45-47%. According to the report of World Coal Association, "A one percentage point improvement in the efficiency of a conventional pulverized coal combustion plant results in a 2-3% reduction in CO2 emissions." In three defined stages, the coal is transformed into electricity. The first conversion of energy takes place in the boiler. Coal is burnt in the boiler furnace to produce heat. Carbon in the coal and Oxygen in the air combine to produce Carbon Dioxide and heat. The second stage is the thermodynamic process.

The heat from combustion of the coal boils water in the boiler to produce steam. In a modern power plant, boilers produce steam at a high pressure and temperature. The steam is then piped to a turbine. The high pressure steam impinges and expands across a number of sets of blades in the turbine. The impulse and the thrust created work in tandem in order to rotate the turbine. The steam is then condensed and pumped back into the boiler to repeat the cycle. To condense the steam each unit is provided with a giant natural draft cooling tower used to cool down the water. Sahiwal power plant uses two natural draft hyperbolic type cooling towers to cool the circulating water. Since water resources are limited, power plants have no other option but to adopt the closed cooling system with cooling towers. Hot water from the condenser pours down from the top and the air moves up from the bottom to top removing the heat in the form of water vapour disappearing in the sky. In the third stage, rotation of the turbine rotates the generator rotor to produce electricity based of Faraday's Principle of electromagnetic induction.

ENVIRONMENTAL PROTECTION MEASURES

Following are the environmental protection measures taken by the company to prevent pollution and ensure environmental friendly operation of the power plant.

1) Dust Control Measures

Electrostatic Precipitators (ESPs) along with Limestone-Gypsum wet desulfurization technology act as a great dust removal system. Integrated dust removal efficiency of the flue gas treatment technologies are within National Environmental Quality Standards. Horizontal ESPs for coal-fired boiler are designed and produced by Fujian Longking Co., Ltd. Each boiler is provided with two double-chambers, four-field,low temperature ESPs with all the four fields provided with a high frequency power supply. The ESP uses a high voltage DC field so that the dust in the flue gas can enter the field in corona status in the direction perpendicular to the electric line. The dust particles are charged electrically in collision charge and diffusion mechanisms and are absorbed to the collecting plate under the action of the electric field force and the electrostatic force. Then the dust on the collecting plate falls to the dust storage device under the action of the rapping device and self-gravity and then is transported to the ash silo through a conveying system so that the flue gases are purified through the ESP.

"Technology is vital. We have to have development in new technology if we're going to solve these environmental problems without throwing humanity back in poverty." Rameez Naam

In this association, the Power Plant has aimed to Plant 30,000 trees in the region. 15,000 trees have already planted

2) SOx Control Measures

The Sahiwal power plant has Limestone-Gypsum Flue Gas Desulfurization designed to remove SOx. After being treated in an electrostatic precipitator (ESP) and pressurized by induced draft fan, flue gas from boiler enters the FGD system. The flue gas entering FGD system flows into the absorber via ducts. In the absorber, flue gas flows from the bottom to the top and limestone slurry is sprayed from top to bottom, allowing for full contact and the facilitation of a chemical reaction between limestone slurry and flue gas.

In this way, more than 90% of SO2 in flue gas is removed. In this chemical reaction, limestone serves as an absorbent that removes SO2 in flue gas producing gypsum (CaSO4•2H2O) as major by-product.

The desulfurized flue gas goes through a mist eliminator and is discharged through the outlet on the top of the absorber. Finally, it is emitted to the atmosphere through clean ducts of the FGD system and the stack. Exhaust Gas from the chimney will have SOx concentration within the National Environmental Quality Standards (NEQS).

3) Wastewater Treatment

The wastewater treatment system is designed keeping in mind the No Wastewater Discharge " Techniques.All the wastewater will be treated according to NEQS prior to reuse. The industrial wastewater includes regular and irregular wastewater. Regular wastewater includes flushing and back washing wastewater from the DM water treatment system, wastewater from condensate the polishing system and drain water from the laboratory building. The regular wastewater will be collected separately and treated on site. The treated water will be reused. Irregular wastewater includes boiler acid cleaning and flushing water, air heater cleaning effluent, boiler start-up effluent, boiler primary start-up effluent and so on. There are acid, alkali, SS, Iron and some others impurity in the waste water, which need to be neutralized with acid and alkali and treated by inoculate-settler, and will be reused after meeting the requirement.

4) Ash Yard

According to the Environmental Impact Assessment approval, seepage control measures are taken. Given Pakistan has no regulations to control ash seepage and permeability, the ash yard is designed according to Chinese standards, dam slope and ash fields laying of polyethylene

geo-membrane (two cloth one membrane) of the design to (artificial barrier layer) has the equivalent permeability coefficient of 1.0x10-7cm/s and 1.5M thick clay layer to control seepage.

5) Coal Yard

Spray guns are installed to timely sprinkle the water on the top of coal pile to ensure the surface moisture remains at about 6% to effectively reduce the volume of coal dust. The coal water tank is installed that will collect the wastewater after the separation of coal to reuse, which can effectively reduce the influence on the groundwater around the power plant. According to the EIA requirements, Project Company has set wind dust-controlling nets around the coal yard, having height 2 m higher than the coal pile, which can effectively control the coal dust.

6) Tree Plantation

The Sahiwal plant's administration has invited a prominent Chinese firm to design and plant the trees on the entire area of the site The company will plant 30000 trees of various niches in Pakistan. In order to improve the ecological environment, continuous efforts will be made to select the trees of both Chinese and Pakistani origin depending upon their ornamental and ecological growth based on Pakistan's climate.

Conclusion

Huaneng Shandong Ruyi (Pakistan) Energy (Private) Limited is considered to be an early-harvest CPEC project, under close collaboration between Huaneng Shandong and Shandong Ruyi Technology Group Co. LTD., with a share of 50% each. However, the Shandong Huaneng company alone is responsible for the operation of the plant. It is a 2x660 MW project, which is one of the first super-critical technology facilities utilized for energy generation plants in Pakistan. It has the capacity to generate over 9 billion KHW of electricity annually, which is enough to meet the demand of over 10 million households. Moreover, the total amount of direct jobs generated under the 'constructional phase' of this project were almost 6,500, employing 2730 (42 percent) from within Pakistan and 3770 (58 percent) possessing foreign nationalities. Similarly, the total direct jobs created under the 'operational phase' are 1,778 from which 1,107 (62 percent) consist of domestic labourers while 671 (38 percent) are foreigners. It is evident from the survey that the foreign workers employed in this phase will return back to their country within 3 years due to the length of their contracts as well as continuous human resource development as practice on the site itself. Keeping this in view, an advantageous approach adopted for hiring labourers in this phase consisted of a policy requiring that all domestic labourers are freshly-qualified engineers from numerous engineering universities within Pakistan. In addition, new advanced technical training institutes are planned to open within the premises with the intention of providing technical training free of cost for the domestic workers. This certainly is an indication that such projects can enhance the pace of economic growth and overall productivity in Pakistan via the procurement of stable, uninterrupted energy sources.

-End-