Report and Recommendation of the President to the Board of Directors

Project Number: 47094-001
November 2013

Proposed Loans
Islamic Republic of Pakistan: Jamshoro Power Generation Project

Asian Development Bank

CURRENCY EQUIVALENTS

(as of 1 November 2013)

Currency unit	–	Pakistan rupee/s (PR/s)
PRs1.00	=	$0.0093632959
$1.00	=	PRs106.80

ABBREVIATIONS

ADB	–	Asian Development Bank
EPC	–	engineering, procurement, and construction
FGD	–	flue gas desulfurization
GDP	–	gross domestic product
GENCO	–	government-owned thermal power generation plants
GHCL	–	GENCO Holding Company Limited
GHG	–	greenhouse gas
HFO	–	heavy fuel oil
ICB	–	international competitive bidding
IDB	–	Islamic Development Bank
JPCL	–	Jamshoro Power Company Limited
kWh	–	kilowatt-hour
LIBOR	–	London interbank offered rate
MW	–	megawatt
NEPRA	–	National Electric Power Regulatory Authority
NO_x	–	nitrogen oxides
O&M	–	operation and maintenance
OCR	–	ordinary capital resources
PAM	–	project administration manual
PIC	–	project implementation consultant
$PM_{2.5}$	–	particulate matter (less than 2.5 microns in diameter)
SO_2	–	sulfur dioxide
TPS	–	thermal power station

NOTES

(i) The fiscal year (FY) of the Government of the Islamic Republic of Pakistan ends on 30 June. “FY” before a calendar year denotes the year in which the fiscal year ends, e.g., FY2012 ends on 30 June 2012.

(ii) In this report, “$” refers to US dollars.

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PROJECT AT A GLANCE

1. Project Name: Jamshoro Power Generation Project **2. Project Number:** 47094-001

3. Country: Pakistan **4. Department/Division:** Central and West Asia Department/Energy Division

5. Sector Classification:

Sectors	Primary	Subsectors
Energy	√	Conventional energy
		Energy efficiency and conservation
		Energy sector development

6. Thematic Classification:

Themes	Primary	Subthemes
Economic growth	√	Promoting macroeconomic stability
Capacity development		Institutional development

6a. Climate Change Impact

None

6b. Gender Mainstreaming

Gender equity theme (GEN)	
Effective gender mainstreaming (EGM)	
Some gender elements (SGE)	
No gender elements (NGE)	√

7. Targeting Classification:

General Intervention	Targeted Intervention		
	Geographic dimensions of inclusive growth	Millennium development goals	Income poverty at household level
√			

8. Location Impact:

National	High

9. Project Risk Categorization: Complex

10. Safeguards Categorization:

Environment	A
Involuntary resettlement	B
Indigenous peoples	C

11. ADB Financing:

Sovereign/Nonsovereign	Modality	Source	Amount ($ Million)
Sovereign	Project loan	Asian Development Fund	30.0
Sovereign	Project loans	Ordinary capital resources	870.0
Total			900.0

12. Cofinancing: Financier	Category	Amount ($ Million)	Administration Type
Islamic Development Bank		150.0	Not ADB-Administered
Total		150.0	

13. Counterpart Financing:

Source	Amount ($ Million)
Government	450.0
Total	450.0

14. Aid Effectiveness:

Parallel project implementation unit	No
Program-based approach	No

I. THE PROPOSAL

1. I submit for your approval the following report and recommendation on the proposed loans to the Islamic Republic of Pakistan for the Jamshoro Power Generation Project.[1]

2. Acute power shortages of up to 20 hours per day have crippled economic growth and caused social unrest in Pakistan.[2] The country needs affordable, dependable base-load power to alleviate the shortage. Coal-fired power plants provide secure, inexpensive base-load power in many countries. The project introduces supercritical coal-fired power generation, which is the best available technology for Pakistan. The environmental impact of this technology would be less than that of the existing heavy fuel oil (HFO)-fired power plants, and the more commonly used subcritical coal-fired power generation technology. The project, which is the first stage of a multi-stage government plan for this site,[3] has three components: (i) construction and 5 years of operational support for a 600-megawatt (MW) (net)/660-MW (nominal) supercritical coal-fired unit, with state-of-the-art emission control devices at the Jamshoro Thermal Power Station (TPS) in Sindh province; (ii) capacity development for coal-fired plant operations; and (iii) environmental remediation of the existing power generation units and site.

II. THE PROJECT

A. Rationale

3. Pakistan is exploring all options to reduce power load shedding and power cost but has few medium-term options for affordable, dependable power supply. Natural gas was the main fuel used for Pakistan's base-load power plants,[4] but the country's dwindling reserves of gas have resulted in increasing use of high-cost imported fuel oil for power generation. This has increased power generation costs and exacerbated the existing financial shortfall, both within the sector and the national economy. Compared to existing, inefficient HFO-fired plants, the higher efficiency supercritical generation units and diversification away from imported fuel oil will enable Pakistan to increase its reliable supply of electricity and lower both costs and greenhouse gas (GHG) emissions.[5]

4. **Energy crisis.** Pakistan's energy crisis depresses its economic performance and fuels social instability. Power shortages equaled about one-third of total demand (4,000–5,000 MW) during most of fiscal year (FY) 2012.[6] Increasing, unpredictable load shedding is estimated to constrain annual gross domestic product (GDP) growth by at least two percentage points. Small- and medium-sized enterprises that employ the largest number of people, but cannot afford back-up electricity generators and fuel, experience the largest impact. GDP growth has averaged 3% since 2007, while GDP growth of 7% is required to generate enough employment to absorb new labor market entrants. Poverty reduction and provision of basic necessities to the

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[1] The design and monitoring framework is in Appendix 1. The project is included in the country operations business plan (2013-2014) for Pakistan.

[2] ADB. 2013. *Asian Development Outlook 2013*. Manila.

[3] The government plans additional 600-MW supercritical coal-fired unit and conversion of existing units to coal.

[4] Gas-fired power generation overtook hydropower in 1996 as the main power source. The share of gas in the thermal generation fuel mix has fallen from 56% (2006) to 44% (2011), while HFO increased from 42% to 54%.

[5] The existing units at Jamshoro TPS use HFO and emit 930 grams of carbon dioxide (CO_2) per kilowatt-hour (kWh). The project would emit 750 grams of CO_2 per kWh and a subcritical unit 850 grams of CO_2 per kWh. Backup generators used to reduce power shortages are substantially less efficient and emit higher volume of CO_2.

[6] Ending June 2012. Government of Pakistan, National Electric Power Regulatory Authority (NEPRA). 2012. *State of Industry Report 2012*. Islamabad.

poor are immediate challenges for Pakistan. Low economic growth creates an environment for recruitment by society's radical elements. The government introduced, as a priority, the new National Power Policy to tackle these issues. PRs480 billion (about $4.5 billion) was paid to fuel companies and independent power producers to clear payment arrears. The government is pursuing gas and power tariff rationalization and energy efficiency measures such as conservation, transmission and distribution loss reduction, and rehabilitation of power plants.[7]

5. **High-power generation cost.** Pakistan has 23,538 MW of installed power generation capacity and 14,000 MW of available capacity on average. Even for the available capacity, HFO-fired power plants are not fully utilized because of a shortage of funds for fuel. The increase in HFO-fired power generation (high production cost) is the major reason the cost-recovery tariff (average tariff) has continuously increased.[8] The government has raised the base tariff by 106% from February 2008 to June 2013, despite this subsidy has increased to PRs5.79 per kilowatt-hour (kWh).[9] This puts enormous pressure on the public finances and the country's balance of payments. For fiscal and economic sustainability, the government must lower electricity generation costs and increase supply to reduce adverse impact from power shortages.

6. **Lowering the generation cost.** The government aims to increase coal-based power generation while decreasing expensive HFO generation. This will require converting existing HFO generation units and constructing new plants.[10] The imported HFO costs several times more than domestic or imported coal, and has higher sulfur content.[11] Electricity generated from coal, through medium-term fuel supply contracts, will also help stabilize the power price. The National Power Policy includes plans to diversify the energy mix.

7. **Renewable and gas-based generation.** Improving energy security and affordability, the government is pursuing large hydropower, gas, and other projects using domestic resources. Pakistan has a low carbon footprint because of the large amount of hydropower and natural gas-based power generation. However, hydropower's contribution to total generation has declined,[12] and accounted for just 32% of power generated in 2012.[13] Only 6,716 MW of a potential of over 40,000 MW of hydropower has been tapped, making large hydropower plants the ideal solution. Although large hydropower is the least cost solution, the high capital cost, the long implementation period, and complex safeguard issues mean this is a long-term option. Small and medium sized run-of-the-river hydropower plants have shorter construction periods but have seasonal and daily output variation which makes them unsuitable for base-load.[14]

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[7] Measures in the National Power Policy are reinforced through agreement with International Monetary Fund (IMF). IMF. 2013. *Pakistan: 2013 Article IV Consultation and Request for an Extended Arrangement Under the Extended Fund Facility*. Washington D.C.

[8] HFO-fired power accounts for 34% of the energy mix; at PRs15.94 per kWh, it makes up 77% of total generation costs. In comparison, the hydropower cost was PRs0.16 per kWh, and gas PRs4.24 per kWh (footnote 6). The cost-recovery tariff has risen from PRs5.5 per kWh in 2008 to PRs14.51 per kWh in 2013.

[9] The subsidies vary monthly according to the consumer mix, load factor, and whether a periodic fuel price adjustment was applied during the period. The average tariff increased from PRs4.26 per kWh to PRs8.81 per kWh in May 2012, and further to PRs 11.11 per kWh in August 2013.

[10] Emissions for conversion from HFO to gas fired plants would vary according to the state of the existing equipment. For the Jamshoro TPS oil-fired units, after conversion the emissions would increase to 1,172 grams of CO_2 per kWh using imported sub-bituminus coal.

[11] Fuel cost savings between a new HFO fired power generation plant and the project would be $535 million annually.

[12] Hydropower's share declined as follows: 72% (1980), 54% (1990), 35% (2000), 32% (2012).

[13] Government of Pakistan, National Transmission and Despatch Company. 2012. *Power System Statistics 2011–12.*

[14] Summer and winter output varies by around 3,000 MW. The government has spent $20 million for the feasibility study of 4,500MW Diamer Basha Dam. The cost is estimated at $12 billion and construction period of 10 years. Ranking of priority projects and sector roadmap are set out in Friends of Democratic Pakistan. 2012. *A Productive and Water-Secure Pakistan*. Islamabad.

Domestic gas-fired generation will decline from the current 26% with the depletion of existing gas fields, and competing demand from industry, transport, and retail customers unless domestic gas supplies are increased.[15] The abundant wind and solar resources are being developed, but their outputs are variable and would not meet the base-load requirements.

8. **Power generation mix.** Oil-fired power generation is expensive, and used for less than 5% of world generation. To be competitive economically, Pakistan cannot afford continued reliance on expensive imported oil for 34% of power generation. Pakistan has one of the lowest carbon emissions, 19% of the world's average.[16] Coal reserves in Pakistan may generate 10,000 MW of power for 350 years. Globally, coal-based power plants generate 40% of power,[17] but account for just 0.07% of generation in Pakistan.[18]

9. **ADB interventions.** ADB is engaged in the energy sector through its four multitranche financing facilities and private sector investments, which fund energy efficiency, transmission, distribution, and renewable energy projects including eight hydropower and two wind power projects.[19] As the sector's largest donor, ADB conducts policy dialogue on reforms, planning, and provides sector assessments to the International Monetary Fund. Ongoing reforms follow the recommendations of the Friends of Democratic Pakistan Energy Sector Task Force, which ADB co-chaired with the government. The report addresses diversification of existing fuel sources.[20]

B. Impact and Outcome

10. The project's impact will be an enhanced energy supply in Pakistan. The outcome will be a more efficient energy mix through diversification from expensive HFO to less expensive coal.

C. Outputs

11. The project will (i) increase capacity of the Jamshoro TPS by installing a 600-MW (net) supercritical coal-fired unit, using an 80/20 blend of imported sub-bituminous coal and domestic lignite when available,[21] and provide 5 years of operation and maintenance (O&M) support; (ii) ensure compliance with the national environmental standards (install emission control devices for the existing units and remediating the site);[22] (iii) enhance capacity of GENCO Holding Company Limited (GHCL) and Jamshoro Power Company Limited (JPCL) by providing financial, technical, and operational training; and (iv) introduce education on coal-fired plant operation. The infrastructure will support government's plan to have an additional 600-MW unit at the same site. The design includes a flue duct interface that will allow adding carbon capture and storage (CCS) when the technology is available.[23]

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[15] Natural gas imports are being explored through pipeline gas and liquefied natural gas. The projects have faced delays. ADB has been the secretariat for the project to pipe gas from Turkmenistan to Pakistan since 2003.

[16] Pakistan's carbon emission per capita is 0.81 tons per year according to the International Energy Agency. 2012. *CO_2 Emissions from Fuel Combustion*. Paris.

[17] International Energy Agency. 2011. *Power Generation from Coal-Ongoing Developments and Outlook*. Paris.

[18] The Lahkra Power Generation Company 150 MW fluidized bed combustion coal-fired power generation plant is the only coal-fired power plant in Pakistan. Only 30 MW is currently available from the units.

[19] List of projects are in Development Coordination (accessible from the list of linked documents in Appendix 2).

[20] Friends of Democratic Pakistan, Energy Sector Task Force. 2010. *Integrated Energy Sector Recovery Report and Plan.* 2010. Islamabad.

[21] In Sindh Province, usable coal production is expected in the next 5–7 years.

[22] The project will also construct hazardous waste storage facility, colony wastewater treatment and landfill, rehabilitate effluent pipeline, and evaporation pond for the existing units.

[23] Capacity development technical assistance, funded by the Carbon Capture and Storage (CCS) Fund, will determine the potential for CCS and explore the technology in Pakistan.

D. Investment and Financing Plans

12. The project is estimated to cost $1,500 million (Table 1). This includes taxes, duties, and interest and other charges. The Islamic Development Bank (IDB) will provide a loan of $150 million to cofinance the project on parallel basis (Table 2).

Table 1: Project Investment Plan
($ million)

Item		Amount[a]
A.	**Base Cost**[b]	
	1. Coal-Fired Power Plant Supercritical Unit	1,096
	2. Capacity Development	10
	3. Environmental and Emission Control	169
	Subtotal (A)	**1,275**
B.	**Contingencies**[c]	**175**
C.	**Financing Charges During Implementation**[d]	**50**
	Total (A+B+C)	**1,500**

[a] Includes $83.9 million of taxes and duties to be financed by the government through tax exemption.
[b] In mid-2013 prices.
[c] Physical contingencies computed at 10% for base cost. Price contingencies computed based on price escalation factors; includes provision for potential exchange rate fluctuation assuming purchasing power parity exchange rate.
[d] Islamic Development Bank financing rate assumed to be LIBOR 5-year fixed swap rate plus 1.15%.
Source: Asian Development Bank estimates.

Table 2: Financing Plan
($ million)

Funding source	Amount	Percentage
Asian Development Bank (ordinary capital resources Loan 1)	840	56%
Asian Development Bank (ordinary capital resources Loan 2)	30	2%
Asian Development Bank (Asian Development Fund)	30	2%
Islamic Development Bank	150	10%
Government of Pakistan	450	30%
Total	**1,500**	**100%**

Source: Asian Development Bank estimates.

13. The government requested two loans totaling $870 million from ADB's ordinary capital resources (OCR) to finance a portion of the project. The first loan of $840 million (OCR Loan 1) will have a 30-year term, including a grace period of 5 years, and will finance civil works. The second loan of $30 million (OCR Loan 2) will have a 20-year term, including a grace period of 10 years, and will finance O&M, and consulting services during the construction phase. The OCR loans will have an annual interest rate determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility,[24] a commitment charge of 0.15% per year (the interest and other charges during construction to be capitalized in the loans), and such other terms and conditions set forth in the draft loan and project agreements. The government also requested a loan in various currencies equivalent to SDR19,380,000 from ADB's Special Funds resources to help finance the remaining portion of the project. The loan will have a 25-year term, including a grace period of 5 years, an interest rate of 2% per annum during the grace period and thereafter, and such other terms and conditions set forth in the draft loan and project agreements. The loan will finance consulting services during the implementation phase and for capacity development. In the event that cofinancing from IDB is not forthcoming, the government will take all necessary and appropriate steps to make available all counterpart

[24] The interest includes a maturity premium of 20 basis points for OCR Loan 1. This is based on the above loan terms and the government's choice of repayment options and dates.

funds required for timely and effective project implementation before contract award for plant construction. However, the government portion will not be less than 15%. The government will relend to JPCL the OCR Loan 1 and IDB loan proceeds at LIBOR+450 basis points, which is in line with the rate previously allowed by the regulator for passing the tariff onto customers. For OCR Loan 1, the term of the relending will be 30 years, including a grace period of 5 years. The government will also relend to JPCL the OCR Loan 2 proceeds, in local currency equivalent, with interest at the rate of 15% per annum inclusive of foreign exchange risk, and a term of 20 years, including a grace period of 10 years. The government will relend to JPCL the ADF loan proceeds, in local currency equivalent, with interest at the rate of 15% per annum inclusive of foreign exchange risk, and a term of 25 years, including a grace period of 5 years.

E. Implementation Arrangements

14. GHCL will be the executing agency, JPCL the implementing agency, and the Ministry of Water and Power the oversight body.[25] A project management unit with sufficient staff will be established within GHCL, with a project implementation unit established in Jamshoro TPS. The engineering, procurement, and construction (EPC) contractor selected to build the plant will provide 5 years O&M support after commissioning as part of its contract.[26] In order to facilitate the government's plan for a second unit (for which there is currently insufficient financing), bidders will be required to bid for an optional second unit on same terms, conditions, and price. This option will be valid for 30 months after award of the first unit. Should actual costs for output 1 of the project be lower than the estimate, residual funds from OCR Loan 1 may be used for a second 600-MW supercritical unit at the same site that meets all ADB policies and requirements. At that stage, suitable due diligence will be carried out and approval sought. International competitive bidding (ICB) will be used to select contractors for installation of flue gas desulfurization (FGD) for existing plants and remediation of the site. A contractor for site preparation will be selected through national competitive bidding. A project implementation consultant (PIC) firm will be recruited using quality- and cost-based selection method.[27] The coal supplier(s) will be selected through ICB, with assistance from the PIC. The project envisages advance contracting and retroactive financing of up to 20% of total financing. The implementation arrangements are summarized in Table 3 and described in detail in the project administration manual (PAM).[28]

Table 3: Implementation Arrangements

Aspects	**Arrangements**		
Implementation period	April 2014–December 2023		
Estimated completion date	31 December 2023		
Management			
(i) Oversight body	Ministry of Water and Power		
(ii) Executing agency	GENCO Holding Company Limited		
(iii) Key implementing agencies	Jamshoro Power Company Limited		
(iv) Implementation unit	Jamshoro Thermal Power Station, 21 staff		
Procurement	ICB	1 EPC contract (Construction of 1x600 MW unit with 5 years of operation and maintenance with an option	$982 million

[25] GENCO Holding Company Limited (GHCL) is a wholly government-owned corporation. Jamshoro Power Company Limited (JPCL) is a wholly owned subsidiary of GHCL.

[26] A procurement expert from a firm with extensive procurement experience with large power plants has been selected to prepare the bidding document.

[27] Weighting has been set at 90% quality and 10% cost, given the lack of experience in Pakistan with management of coal-fired power plants. The selection will follow ADB Guidelines on the Use of Consultants (2013, as amended from time to time).

[28] Project Administration Manual (accessible from the list of linked documents in Appendix 2).

Aspects	Arrangements		
		of a second unit of 600 MW)	
	ICB	1 EPC contract (remediation of site)	$9 million
	ICB	1 EPC contract (FGD installation for existing units)	$160 million
	NCB	1 work contract (Site preparation)	$5 million
Consulting services	QCBS	817 person-months	$15 million
Capacity Development	QCBS	Full Technical Proposal	$10 million
Retroactive financing and/or advance contracting	The recruitment of project implementation consultant will require advance contracting and retroactive financing		
Disbursement	The loan proceeds will be disbursed in accordance with ADB's *Loan Disbursement Handbook* (2012, as amended from time to time) and detailed arrangements agreed upon between the government and ADB.		

ADB = Asian Development Bank, EPC = engineering, procurement, and construction, FGD = flue gas desulfurization, GENCO = government-owned thermal power generation company, ICB= international competitive bidding, NCB = national competitive bidding, QCBS = quality- and cost-based selection.
Source: Asian Development Bank.

15. IDB will cofinance design and construction of the coal-fired power plant under the project.[29] As it is not possible to separately procure individual components of the EPC contract to build the coal-fired power plant, procurement of this contract will be conducted jointly by ADB and IDB. It is proposed to expand country eligibility for procurement of the EPC contract to build the coal-fired power plant by allowing this procurement in both ADB and IDB member countries.

III. DUE DILIGENCE

A. Technical

16. Jamshoro TPS was selected because of its proximity to Bin Qasim Port and the existing rail system for importation of coal, land availability, and construction access. Jamshoro TPS currently has one oil-fired and three oil and gas dual-fired power generation units, with 850 MW installed of which 700 MW is available.[30] Coal will be delivered by ship and then transported by train from Bin Qasim Port (160 kilometers from Jamshoro TPS). The railway tracks are in good condition and there are sufficient facilities at the port to handle the amount of coal needed for the project. Moreover, the railway line will be rehabilitated and new locomotives will be purchased for the project to ensure reliable delivery.[31] A medium-term coal supply agreement will be signed before EPC contract award.[32] Water is supplied via intake pipelines in the Indus River; an additional pump station and pipelines will be constructed for the new unit, with wastewater returned to the river after treatment. A new 500-kilovolt transmission line with 1,500-MW transmission capacity, financed through tranche 3 of ADB's Power Transmission Enhancement Investment Program, will evacuate the generated power.[33]

17. To achieve affordability, energy security, reliable base-load and diversification from HFO, coal-fired power plants are the optimal medium term option. Most countries begin coal-fired generation with subcritical plants; these are easier to operate, more rugged, and more

[29] This cofinancing will be provided on parallel basis and will not be administered by ADB.
[30] In 2012, Jamshoro TPS generated only 20% of its installed capacity because of a lack of fuel.
[31] A coal transport agreement that includes coal unloading and satisfactory safety measures will be signed prior to the coal supply contract award. A private sector concession will be considered by the Pakistan Railway Authority.
[32] The coal supply contract (minimum 3 years) has been advertised in local and international newspapers.
[33] The power purchase agreement will include penalties for the transmission company if the transmission line is not available when the project is commissioned. An additional 1,320 MW of power can be reliably transmitted from Jamshoro to the national grid according to the transmission load study. ADB. 2006. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranche Financing Facility to the Islamic Republic of Pakistan for the Power Transmission Enhancement Investment Program.* Manila.

reliable than supercritical plants, but have higher emissions and lower efficiency. As envisioned in ADB's Energy Policy,[34] during project development supercritical technology was introduced by ADB ensuring cleaner technology to Pakistan. The CO_2 emission savings comparing the two technologies is estimated at 400,000 tons of CO_2 per year.[35]

18. A mix of 20% domestic lignite and 80% imported sub-bituminous coal is the optimal design, based on the technological, economic, and environmental analysis. The boiler system with single reheater will perform at no less than 93.5% efficiency at low heating value with this blend. The unit will be equipped with a wet scrubber with limestone FGD, which will remove at least 95% of sulfur dioxide (SO_2) from exhaust flue gases. A highly efficient (>99.9%) electrostatic precipitator will be installed to remove fine particles from the exhaust gases and minimize the particulates. A low nitrogen oxides (NO_x) burner combined with stage combustion will be used and a selective catalytic reduction process will be used to further reduce NO_x emissions. The project will finance FGDs for existing oil-fired units at Jamshoro TPS to further reduce SO_2 emissions if necessary to meet environmental standards.[36]

19. The project will reduce power shortage and replace informal sources of power generation, which is expected to offset about 503,000 tons of the plant's CO_2 emissions annually.[37] Compared with subcritical coal-fired power generation and existing Jamshoro units using HFO, the project would emit 388,000 tons and 639,000 tons less CO_2 (footnote 5) annually. Reflecting ADB's broad-based involvement in the sector, ADB's overall Pakistan energy portfolio is CO_2 negative with an expected reduction of 3.5 million tons from existing projects annually. To further reduce the carbon footprint, the PIC will also assess additional options to offset GHG emissions through reforestation. Ash produced from the unit is expected to be recycled; however, 100 acres of available land will be purchased for a lined ash disposal pond to store the ash in case there is a lag in demand from cement plants and other potential customers. If ash recycling agreements cannot be signed by the commissioning, JPCL will purchase additional 200 acres of land in accordance with ADB's Safeguard Policy Statement (2009) and resettlement plan. Ash Management Plan is detailed in the PAM (footnote 28). The cooling system will need to withstand extreme hot summer weather, and the bidders will propose optimal solutions including an air, wet, or hybrid cooling system. The system will be designed, supplied, and installed by an EPC contractor. Construction will take 40–48 months.

B. Economic and Financial

20. The project adopts a least-cost approach to enhancing power generation capacity. Project economic viability was assessed based on expected benefits and costs over the project's economic life. The project is economically viable, with an economic internal rate of return of 36.3%, exceeding the economic opportunity cost of capital of 12%. Incremental revenues arising from sale of electricity were calculated based on willingness to pay, estimated

[34] ADB. 2009. *Energy Policy*. Manila.

[35] The supercritical technology is well established but is slightly less efficient than ultra-supercritical plants. Ultra-supercritical plants require experienced operators because of their exacting design. At a low heating value, an ultra-supercritical plant can reach an efficiency of 45%, a supercritical plant 44%, and subcritical technology 38%.

[36] If the existing units are shut down after commissioning of the new supercritical units, FGD will not be necessary. If they are run on high-sulfur HFO or converted to coal-fired units, FGD is required.

[37] Estimated 31% of the electricity generated from the project will replace informal power generation. Ash recycling will result in offsetting 115,000 tons of CO_2 emissions. The project's comprehensive monitoring program for GHG emissions will include the installation of a continuous emission monitoring system and third-party monitoring.

at PRs21 per kWh based on a survey.[38] In the financial analysis the project benefit was calculated as per NEPRA guidelines for coal-fired generation projects. By applying the financing terms and other commercial parameters of the project,[39] the tariff was PRs8.88 per kWh. The financial internal rate of return of the project in real terms is 8.7%, which compares favorably with the estimated weighted average cost of capital of 6.7%, indicating that the project is financially viable. Sensitivity analysis shows robustness under unfavorable circumstances.

C. Governance

21. **Procurement.** The implementing agency's capacity to implement procurement of this type is low, and the inherent procurement risks are high due to the contract value and technical complexity. The PIC consultant will undertake day-to-day management of the procurement process, including ensuring that due diligence is conducted on the proposals, and the findings are included in the bid evaluation and recommendations. Based on PIC's recommendation, the project steering committee will consider (i) evaluation reports and award recommendations, (ii) plant design and any changes during implementation, (iii) the implementation plan, and (iv) contract variations. ADB's concurrence is requested after project steering committee's approval.

22. The financial management assessment of the implementing agency is generally satisfactory, with accepted accounting principles and conventions in compliance with international financial reporting standards being applied. The implementing agency has been audited by external international audit firms. The company suffers from losses primarily because of the sector's liquidity crisis. The financial rehabilitation roadmap with specific milestones was developed to improve the financial sustainability of the implementing agency (footnote 28). ADB's Anticorruption Policy (1998, as amended to date) was explained to and discussed with the executing and implementing agencies. The specific policy requirements and supplementary measures are described in the PAM (footnote 28).

D. Poverty and Social

23. The project will result in a more reliable electric power supply, and help in meeting peak demand, which is expected to benefit industrial productivity. Industrial production and manufacturing contribute about 25% of GDP, and are responsible for 18% of formal employment. Opportunities for women's employment in manufacturing are important, with women holding 30% of formal jobs in the textile industry. The project will employ 1,600 people for construction and equipment installation. In line with international norms, about 175 staff will be hired for O&M of the new unit.

E. Safeguards

24. **Environment.** This project is categorized as "A" for environment. The project will benefit the environment by addressing the existing environmental damage and restoring the site, and by significantly reducing the sulfur emissions of power generated (per kWh) in comparison with existing generation using high-sulfur HFO. In compliance with ADB's Safeguard Policy Statement (2009), an environmental audit of the existing facility and environmental impact assessment study of the planned two new units were prepared, with the drafts disclosed on 26 June 2013. The new

[38] Four consumer categories were surveyed: residential, agricultural, commercial, and industrial. For a 12% economic internal rate of return, the willingness to pay would be PRs8.71 per kWh, which is below the average tariff.

[39] A 6% interest rate and 17.45% return on equity was applied. The per-unit price of indigenous coal was assumed to be the same as the per-unit price of imported coal. $120.6 per ton was used. There is no domestic market for the quantity of coal needed.

coal-fired unit will produce ash and soot, requiring specific handling (para. 19). Site remediation will address existing contamination issues, such as oil-contaminated soil, waste metals, and asbestos disposal. Mitigation measures supported under this project include (i) effluent water management, (ii) construction of a hazardous waste storage facility, (iii) development of a landfill site for colony waste, (iv) rehabilitation of evaporation ponds, (v) emissions control measures to address excessive SO_2 emissions, and (vi) ash disposal and traffic management. The implementing agency will implement an annual comprehensive monitoring program to measure GHG emissions and effluent. Training will be held for engineers to mainstream environmental safeguards. The project is estimated to emit 3.3 million tons of CO_2 annually using an 80/20 blend of imported sub-bituminous coal and domestic lignite. Background levels of fine particulate matter (less than 2.5 microns in diameter [$PM_{2.5}$]) in the project area exceed the applicable standards.[40] The high levels of $PM_{2.5}$ are attributed to informal power generation[41] using dirty fuels and less efficient generation,[42] and are at present widely used to meet the country's power shortages. An offset for the plant's emissions of $PM_{2.5}$ will be designed and implemented, under technical assistance, through further assessment of air quality and pollution sources within the airshed.

25. **Social.** The project is categorized as "B" for resettlement and "C" for indigenous peoples. Approximately 100 acres of land belonging to 18 landowners (with a total of 106 family members) is required for an ash pond at Jamshoro TPS. Consultations were held with the owners and they are willing to negotiate with JPCL on the price. A land acquisition and resettlement plan was prepared and disclosed on ADB's website on 19 September 2013; it will be updated to reflect the final list of owners and price agreed between the owners and JPCL.

F. Risks and Mitigating Measures

26. Major risks and mitigating measures are summarized in Table 4. These and other risks are described in detail in the risk assessment and risk management plan.[43]

Table 4: Summary of Risks and Mitigating Measures

Risks	Mitigating Measures
Jamshoro Power Company Limited is not paid sufficient amounts for operations.	At least 1 month of fuel cost and 1 year of maintenance cost will be kept in separate escrow accounts by Jamshoro Power Company Limited.
Government decides to change to cheaper dirtier coal.	Medium-term coal supply agreements (minimum 3-year duration) will be signed. Use of imported low sulfur coal will be a covenant in the loan agreement. An operational support contract with performance assurance and PIC for monitoring will be in place for the first 5 years of operation. Using below-specification coal would degrade the unit and decrease efficiency.
Environmental benefits not realized due to mismanagement.	Adhering to ADB's safeguard policy will be a covenant in the loan agreement. Sindh Environmental Protection Agency will monitor the national standards; environmental safeguard staff and consultants will be recruited to monitor the environment mitigation plan implementation as well as third party audits.
Lack of cost recovery in the energy and power sectors costs render operations unsustainable.	The government has identified the power sector as a priority and has taken difficult measures in implementing the National Power Policy. Measures for power sector sustainability were agreed with the IMF in September 2013.

[40] Plant emissions will contribute to the exceedance of ambient fine particulate matter standards by 4%; in a non-degraded airshed, this would be well below the threshold of significance, which is set at 25% by the World Bank Environment Health and Safety Guidelines.

[41] Technical assistance will be provided to undertake comprehensive air quality assessments to help rationalize the ambient standards and implement measures needed to improve air quality.

[42] Diesel, biomass, kerosene, and firewood.

[43] See Risk Assessment and Risk Management Plan (accessible from the list of linked documents in Appendix 2).

Risks	Mitigating Measures
Imported and domestic coal cannot be delivered to the plant by rail timely and safely.	The government will ensure adequate equipment is operational prior to coal deliveries. The PIC will explore private sector options for coal delivery to the project site by rail. Bin Qasim Port has confirmed the availability of facilities for handling imported coal.

ADB = Asian Development Bank, IMF = International Monetary Fund, PIC = project implementation consultant.
Source: Asian Development Bank.

IV. ASSURANCES AND CONDITIONS

27. The government, GHCL, and JPCL assured ADB that implementation of the project shall conform to all applicable ADB policies including anticorruption measures, safeguards, gender, procurement, consulting services, and disbursement as described in detail in the PAM and loan documents.

28. The government, GHCL, and JPCL agreed with ADB on certain covenants for the project, which are set forth in the loan agreements and project agreement.

29. The loans will not be effective until (i) the standards of the Sindh Environmental Protection Agency for $PM_{2.5}$ have been revised to permit a coal-fired power plant in Sindh; and (ii) a subsidiary loan agreement between the government and JPCL for the relending of the ADB loans has been signed and become effective in accordance with its terms.

V. RECOMMENDATION

30. I am satisfied that the proposed loans would comply with the Articles of Agreement of the Asian Development Bank (ADB) and recommend that the Board approve the following loans to the Islamic Republic of Pakistan for the Jamshoro Power Generation Project:

(i) a loan of $840,000,000 from ADB's ordinary capital resources, with interest to be determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility; for a term of 30 years, including a grace period of 5 years; and such other terms and conditions as are substantially in accordance with those set forth in the draft loan and project agreements presented to the Board;

(ii) a loan of $30,000,000 from ADB's ordinary capital resources, with interest to be determined in accordance with ADB's LIBOR-based lending facility; for a term of 20 years, including a grace period of 10 years; and such other terms and conditions as are substantially in accordance with those set forth in the draft loan and project agreements presented to the Board; and

(iii) a loan in various currencies equivalent to SDR19,380,000 from ADB's Special Funds resources, with an interest charge at the rate of 2% per annum during the grace period and thereafter; for a term of 25 years, including a grace period of 5 years; and such other terms and conditions as are substantially in accordance with those set forth in the draft loan and project agreements presented to the Board.

31. I also recommend that the Board approve the proposal in paragraph 15 of this report to permit procurement in non-member countries of ADB for works produced in such non-member countries of ADB.

Takehiko Nakao
President

18 November 2013

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and Reporting Mechanisms	Assumptions and Risks
Impact Enhanced energy supply	Peak load shedding reduced from 5,000 MW (2013) to 3,000 MW by 2023 Large-scale manufacturing growth of at least 2% by 2023, compared to 1.2% (2011)	NTDC Electricity Marketing Data Pakistan Annual Economic Yearbook	**Assumptions** Political stability and security maintained The government commits to support ongoing reform of the power sector under the National Power Policy and is dedicated to the elimination of load shedding through enhanced, lower-cost supply **Risk** Insufficient enabling environment for private sector investment
Outcome More efficient energy mix (through diversification from expensive HFO)	Additional 4,468 GWh per annum of power generated from coal by 2019 (baseline: 89,238 GWh in 2010) Share of HFO in the power generation mix decreased to 30% by 2019 (baseline: 34%, August 2012) Share of clean coal in the power generation mix increased to 3% by 2019 (baseline: 0.14% installed, August 2012) NEPRA energy purchase price for Jamshoro TPS reduced by 30% by 2019 (baseline: $0.212/kWh, June 2012)	NTDC Electricity Marketing Data NEPRA determination: monthly fuel price adjustment	**Assumption** Sufficient coal supply available and secured through medium-term coal supply agreements **Risks** JPCL is not paid sufficient amounts for maintenance and fuel Limited O&M capacity of Jamshoro TPS may be insufficient to optimize the coal-fired power unit
Outputs 1. Jamshoro TPS capacity increased	Installation of one 600 MW (net) supercritical coal-fired unit and start of implementation of the 5-year O&M contract, by 2019	Executing agency's project completion report, consultants' reports Commissioning certificate	**Assumptions** The government is committed to providing timely counterpart support

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and Reporting Mechanisms	Assumptions and Risks
2. National environmental standards compliance ensured	Bioremediation of the contaminated soil by 2023.[a] Construction of hazardous waste storage facility, effluent pipeline, landfill for colony waste, and proper lined evaporation ponds by 2019. Installation of emission control devices (FGD) for the existing units by 2019.	Environmental audit report Commissioning certificate Executing agency's project completion report	**Risks** Jamshoro TPS O&M capacity is below optimal level Weak environmental management at Jamshoro TPS Absence of ash buyers Untimely coal delivery
3. Executing agency and implementation agency staff capacity enhanced	At least 50 relevant staff (male and female) pass the assessment test on project administration, safeguard, procurement, financial, and technical O&M aspects by 2019	Executing agency's project completion report	
4. Coal-fired power plant operation introduced in technical school curriculum	Inclusion of at least one subject related to coal-fired plant operation in a technical school[b] by 2019		

Activities with Milestones

1. Jamshoro Thermal Power Station capacity increased

1.1 EPC contractor selected by March 2015
1.2 Unit commissioned by February 2018
1.3 Operation and maintenance contract of the new supercritical unit completed and project handed over to JPCL by 2023

2. National environmental standards complied by Jamshoro Thermal Power Station

2.1 Site remediated by December 2016
2.2 Emission control devices installed by December 2017

3. Executing agency and implementation agency staff capacity enhanced

3.1 Staff capacity of the executing and implementing agencies assessed by March 2014
3.2 Capacity development plan prepared by May 2014

Inputs

Loan

ADB: $900 million ($30 million ADF; $870 million OCR in two separate loans amounting $840 million and $30 million respectively)

Government: $450 million

Cofinancing: $150 million (Islamic Development Bank)

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and Reporting Mechanisms	Assumptions and Risks
3.3 Resource persons engaged by August 2014 3.4 Training manuals developed by December 2014 3.5 Training commenced by March 2015 **4. Coal-fired power plant operation introduced in training curriculum** 4.1 Partnership with technical school facilitated by June 2014 4.2 Course on CFPP operation designed by May 2015 4.3 Course on CFPP operation introduced by September 2015			

ADB = Asian Development Bank, ADF = Asian Development Fund, CFPP = coal-fired power plant, EIA = environmental impact assessment, EPC = engineering, procurement, and construction, FGD = flue gas desulfurization, HFO = heavy fuel oil, GHCL = GENCO Holding Company Limited, GWh = gigawatt-hour, JPCL = Jamshoro Power Company Limited, kWh = kilowatt-hour, MW = megawatt, NEPRA = National Electric Power Regulatory Authority, NTDC = National Transmission and Despatch Company, O&M = operation and maintenance, OCR = ordinary capital resources, TPS = thermal power station.

[a] Bioremediation of the contaminated soil will not affect the target dates for the outcome indicators.

[b] Agreement with Water and Power Development Authority technical school or other equivalent school will be signed prior to EPC contract award.

Source: Asian Development Bank.

LIST OF LINKED DOCUMENTS

http://www.adb.org/Documents/RRPs/?id=47094-001-3

1. Loan Agreement (Ordinary Operations)
2. Loan Agreement (Special Operations)
3. Project Agreement
4. Sector Assessment (Summary): Energy
5. Project Administration Manual
6. Contribution to the ADB Results Framework
7. Development Coordination
8. Financial Analysis
9. Economic Analysis
10. Country Economic Indicators
11. Summary Poverty Reduction and Social Strategy
12. Environmental Impact Assessment
13. Resettlement Plan
14. Risk Assessment and Risk Management Plan

Supplementary Documents

15. Technical Due Diligence Report
16. Financial Performance and Management Assessment
17. Cofinancing Agreements with Islamic Development Bank
18. Procurement Capacity Assessment