Final Report

Capacity Building support to the Energy Directorates in the Energy Division of the MEW and the Provincial Energy Committees of MEW

PN: 2015.2000-6-001.02

Mittal Processors Private Limited
May 2018

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Acronyms

Acronym	Description
AREU	Afghanistan Renewable Energy Union
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit
DABS	Da Afghanistan Breshna Sherkat
RE	Renewable Energy
MPPL	Mittal Processors Private Limited
PEC	Provincial Energy Committee
GIRoA	Government of Islamic Republic of Afghanistan
IDEA	Institutional Development for Energy in Afghanistan
MEW	Ministry of Energy and Water
MRRD	Ministry of Rural Rehabilitation and Development
ToR	Terms of Reference
IDLG	Independent Directorate of Local Governance
SSD	Sectoral Services Directorate
ToT	Train the Trainers

1 Executive Summary

The Government of Islamic Republic of Afghanistan (GIRoA) is increasingly laying emphasis on utilizing Afghanistan's domestic energy resources to increase its power generation capacity. The Ministry of Energy and Water (MEW) governs the power sector in the country. It is responsible for formulating policies, strategies and plans for the development of power sector and implementation of these.

The efforts of MEW are at the national strategic levels however, in order to achieve the national goal of power shortage free country, a lot of capacity is to build at the lower level of the governance so as the to improve on the access to Energy. Accordingly, the PEC's were established as an institutional body at provincial level with the objective to support the GIRoA through MEW for implementation of Energy sector policies at provincial level.

GIZ is supporting the GIRoA through various programmes such as Afghan-German Cooperation Programme titled "Institutional Development for Energy in Afghanistan" (IDEA). The primary focus of IDEA program is to support the MEW and Provincial Energy Committees (PECs) of MEW for institutional capacity development. The Capacity building has been done by formulating a questionnaire and sending it to the members of PEC. Approx. 30 PEC members responded to this questionnaire from which information and data were gathered to prepare the training report. It was noted that most of the PEC members have basic understanding of RE project development and Project Management. The participants were aware of basic understanding of Solar, Hydro and Wind project development.

Based on the analysis of the questionnaires and personal interaction with PEC members the training topics and methodology were finalized. During the session at MEW Kabul, approx. 40 PEC members were divided into five (5) groups and each group was assigned a subject as per RE potential in their provinces and prepare a report on them for eg. Solar, Hydro or Wind project development. Each group presented their project reports, which MPPL and GIZ team reviewed and subsequently provided their feedback. It was a great learning experience for the participants on understanding the basics of RE proposal writing.

The GIRoA in its Renewable Energy Policy of 2015 has a target for deploying about 4,500 MW of Renewable Energy (RE) capacity by 2032, which is equivalent of 95% of the total Energy mix of 6,000 MW as per the target of Power Sector Master Plan (PSMP). In order to achieve this target a lot works in terms of capacity development need to be undertaken at local/sub government level so that the projects are developed in a time bound manner. Therefore, capacity development at provincial level on various aspects of RE project development assumes significant importance.

In conclusion, PEC in current form is not sustainable due to various challenges such as limited presence of MEW in the provinces and excessive reliance on GIZ funding support. In order to overcome the challenges and make PEC self-sustainable, we are suggesting an alternate structure which would help in smooth transition of PEC roles and responsibility to a parallel agency (IDLG) having a strong local presence in the provinces. This alternate agency would contribute to energy planning, coordination and supply at provincial level. The detailed transition plan is provided in section 5 of the report.

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2 Project Objective and Scope of Work

2.1 Project Objectives

Afghanistan, a landlocked and mountainous country has suffered chronic instability and conflict during its modern history that its economy and infrastructure are in ruins. With the infusion of billions of dollars in international assistance, the economy of Afghanistan has made significant improvement. The infrastructure of any country is the backbone of its economy, therefore growth in the infrastructure sector leads to its economic development. Electricity is one of the key infrastructure element playing an important role in the development of the country. As per the power sector strategy of Afghanistan, Energy is Afghanistan's economy hope for growth. The assured availability of power at affordable price to the citizens of the country can guarantee improve living standards and promote economic growth.

War, under-investments, lack of technical and management capacity and funds have decimated the power sector of the country. The Government of Islamic Republic of Afghanistan (GIRoA) has taken various initiatives with the support of International funding agencies such as the World Bank, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), The United States Agency for International Development (USAID), Asian Development Bank (ADB) etc. to rebuilt the energy infrastructure and increase accessibility of Afghanistan citizens to electricity. GIZ is supporting the GIRoA through various programmes such as Afghan-German Cooperation Programme titled "Institutional Development for Energy in Afghanistan" (IDEA).

The Government of Afghanistan is increasingly laying emphasis on utilizing Afghanistan's domestic energy resources to increase its power generation capacity. The objective is to become self-reliant in electricity supply and reduce dependence on imported power, which currently constitutes about 70% of the total electricity consumption in the country.

The installed generation capacity in Afghanistan is only about 500 MW, which is largely based on hydro and diesel generation. The present power demand is largely met by importing power from the neighboring countries i.e. Uzbekistan, Tajikistan, Turkmenistan and Iran.

The Ministry of Energy and Water (MEW) governs the power sector in the country. It is responsible for formulating policies, strategies and plans for the development of power sector and implementation of these. It thus takes a vital role for the sustainable development of the power sector in the country.

The efforts of MEW are at the national strategic levels to achieve the goal of reliable, cheap and uninterrupted supply of power to its citizens through large scale investments in power generation and distribution. However, in order to achieve the above national goal of shortage free country, a lot of capacity is to build at the lower level of the governance so as the to improve on the access to Energy. Accordingly, the PEC's were established as an institutional body at provincial level with the objective to support the GIRoA through MEW for implementation of Energy sector policies at provincial level.

The primary focus of IDEA program is to support the MEW and Provincial Energy Committees (PECs) of MEW for institutional capacity development. The key areas of support include institutional development, capacity building, technical & commercial improvements, creation of appropriate legal and policy framework and good governance.

2.2 Scope of work

The scope of work under this project was to provide support to Provincial Energy Committees (PECs) for the following tasks:

i. Conduct Training Needs Assessment for PECs and develop training plans accordingly.
ii. Implementation of PECs training plan.
iii. Support establishment of PECs Technical Working Group and develop its TOR.
iv. Review the Annual Work Plans and Capacity Development Plan of Provincial Energy Committees (PECs) and improve these, if required.
v. Implementation of their Annual Work Plans and provide the training required.
vi. Develop and introduce a communication mechanism to facilitate coordination between PECs and the Central Government and bring this to the attention of the Deputy Minister, MEW and other national energy stakeholders.
vii. Assist and facilitate the PEC's in conceptualizing and implementing their Annual Work Plan so that they are aligned towards implementation of MEW's Capacity Development Plan for PEC.

To develop the Capacity of PEC members to:

i. review, understand and draft Energy sector short and mid-term planning, programming and project management
ii. make project proposals as per the requirements and guidelines of MEW
iii. do feasibility study of the projects
iv. to develop skills to monitor the progress of the ongoing projects
v. Assist PEC's in all functions related to preparation of project related documentation
vi. Assist PEC's in capacity development and training such as Report writing, Presentation making and MIS preparation.
vii. Identify the exact requirement/need of the officials of PEC's for imparting Technical training on Renewable Energy and Energy Efficiency measures.
viii. Design data entry forms/layouts/templates in word/excel for the data base and all MIS reports.

3 Training Methodology and Capacity Building

3.1 Training Methodology:

The training methodology was based upon international training manuals and good practices and documentation. A coherent training program, was structured so that the training can be completed by experts and consultants in a reasonable time.

We used the following training methodology for all the trainings:

- A survey was conducted through a questionnaire to gather information on understanding of PEC members on the proposed training topics. Personal interaction with PEC team was also done during their visit to India so as to understand their training requirement.
- Based on the results of the questionnaire a Gap analysis of survey was conducted and training need of PEC members were finalized.
- The training documents were prepared both in English language and were shared with PEC members during the training session.
- 2 days online Train the Trainers (ToT) training was conducted for GIZ team which helped them to actively participate in the training as faculty during the session
- Training sessions were conducted at MEW offices in Kabul. MPPL along with GIZ team as co trainer delivered the training sessions.
- 35-40 PEC trainees were divided into 5 groups, representing each of the participating provinces
- All groups were asked to prepared 5 project reports (2 Solar, 2 MHP and 1 Wind)
- At the end of training session all the groups were asked to present their proposal
- Each proposal was reviewed by the consultants and feedback was provided to the participants and GIZ team.

3.2 Capacity Building of PEC-Training Implementation

Training Period and Venue:

The Capacity Building workshop took place from 29th April to 2nd May 2018 in Kabul. The first training session of 29th April' 2018 took place at MEW office and from 30th April to 2nd May 2018 at Wapika Complex, MEW, Airport Road, Kabul, Afghanistan. The team arrived at Kabul one day before, on 28 April 2018, in order to fine-tune the the training agenda, methodology and coordination of facilitation.

Training Team:

The members of the training team were Mr. Arun Kumar, Team Leader; Mr. Shashwat Srivastava, Expert along with Mr. Abdul Walid Rahimi, Institutional Development for Energy in Afghanistan (IDEA), Regional Programme Coordinator, GIZ as an facilitator and translator in the local language. A copy of all the presentations and training material was shared with GIZ team and also with the participants.

Further, in order to prepare for the final training, GIZ team was provided 2 days online Train the Trainers (ToT) training on training topics. This helped the GIZ team to actively participate in the training as faculty during the session.

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Agenda:

The training team agreed a draft agenda prior to the capacity Building-workshop which was provided by Mr. Abdul Walid Rahimi, Institutional Development for Energy in Afghanistan (IDEA), Regional Programme Coordinator, GIZ, as follows:

Day 1

- Welcome address and program Introduction
- Introduction to the Project Management, MS Word and Power Point
- Business Communication & Emails at work

Day 2

- Recap of Day 1
- Business Writing
- Project Management Understanding & how the projects are going to be integrated in the national and provincial plan

Day 3

- Recap of Day 2
- Project Management Understanding (Solar, Wind and Mini Hydro (MHP))
- How to prepare project proposal
- MIS Preparation and Analysis; Survey, feasibility study and project design (PV, Wind and MHP Projects)

Day 4

- Recap of Day 3
- Project Management Understanding (Solar, Wind and Mini Hydro (MHP))
- How to prepare project proposal
- Stakeholders Management and professional coordination

Adjustments had to be made to the agenda, in light of restricted movement for the international Consultants due to poor degree of security scenario in the city.

Participants:

The training-workshop was attended by various agencies: PEC and MEW. Approx. 35-40 participants participated in the training session. The list of participants is attached as Annexure 2.

The Training-Workshop:

Day 1 - The training-workshop was opened by Mr. Arun Kumar, CEO, MPPL by welcoming the participants, and asking participants to introduce themselves, and establishing the training methodology. The participants were asked to divide into 5 groups, representing each of the participating provinces and were given topics to choose among Solar, Wind and MHP project management. He then started the first session on the concept of Project Management basics. The Report Writing and Executive Summary format was also explained to the participants so that they can prepare the final report in the format. The following topics were covered in details:

- Design manual on Report Writing
  - Title and Cover Page
  - Table of Contents and Executive Summary
  - Introduction and Body (Technical and Financial part)
  - Conclusion, Recommendation and Appendix

- Project Management Basics
  - The components of a project
  - What project management is
  - Understand the project life cycle
  - Project Scope, Schedule, Cost, Quality & People
  - Manage Project Communication
  - Identify & Manage stakeholders
  - Identify the problem or opportunity
  - Developing Project Plan & How to Run a project
  - Monitoring progress & performance
  - How to close & transition projects

During the course of the training he shared the basic elements; and post training conducted question-answer session in which the participants cleared their doubts on each of the presentations. International sample reports on Solar, Wind and MHP project development were presented using power point presentations.

Day 2 – Started with a presentation on Project Management Basics and Understanding of Project Management of Solar and Wind Projects. Mr. Samrat Sengupta, AVP, MPPL covered the following topics in details:

- Solar Project Management
  - Detail Site Analysis
  - Basic Engineering
  - Technology Selection
  - Project Feasibility Report (PFR)
  - Detailed Project Report (DPR)
  - Regulatory Assessment
  - Financial Planning
  - Detailed Engineering of the Project
  - Procurement
  - Construction Monitoring
  - Inspection
  - Commissioning

- Wind Project Management

i. Need Assessment: Demand – supply scenario assessment for project lifetime, ensuring offtake solutions and expected revenue

ii. Project Potential Assessment
  - Identification of high-wind zones in the geography under consideration (mesoscale GIS map)
  - Identification suitable land
  - Investment grade wind resource assessments
  - Identification of technology
  - Evacuation plan

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- Preparation of DPR
- Regulatory Approvals
- Finalization and execution of Power Purchase Agreement
- Financial Structuring
- Project Commissioning
- Operation and Maintenance with effective real-time monitoring

The session ended with question-answer session in which the participants cleared their doubts on each of the presentations.

Day 3 – The focus on Day 3 was to make participants write a small report on the topics chosen on Day 1 on Solar, Wind and MHP projects. The 5 groups which were created on Day 1 were assisted by consultant and GIZ team to prepare the report.

- **Group 1**: Wind Project Herat Province
- **Group 2**: Solar for Badakhshan Province
- **Group 3**: MHP (Hydro) for Takhar Province
- **Group 4**: MHP (Hydro) for Badakhshan Province
- **Group 5**: Solar for Balkh Province

During the session, participants cleared various doubts on report writing and on project management concepts of Solar, Wind and MHP. Mr. Samrat Sengupta, AVP, MPPL also shared his experience of Solar, Wind and Hydro projects of India. The participants enquired about various technical parameters related to MHP in India.

Day 4 – Each group was asked to present their report to all the participants. The feedback and comments on the report was provided by the Consultants for finalization of the report. The reports are attached at Annexure 1. A presentation was also given on Stakeholder Management. The following topics were covered in details:

- Stakeholder Management
  - Identify the stakeholders
  - Stakeholders – Influence, Interest matrix
  - Communication mechanism
  - 5 Tips for effectively manage stakeholder

During the second half of the session, Deputy Minister, MEW HE Mr. Khulmi presented the training completion certificates to over 40 participants and also talked to few of the participants to understand the relevance and applicability of such training. He also appreciated the mode of conduct of physical training and commented that he looked forward to such events in future as well

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4 Outcome of the Training-Workshop

During this training session, despite the time constraint due to security concerns, there was a very active participation by the PEC and MEW members. The participants agreed on the following outcome

- Capacity building of the PEC team in preparing and writing proposals w.r.t Solar, Wind and MHP projects
- Capacity building of the PEC team on Project Management of Solar, Wind and MHP Projects
- Developed skills of the PEC team by providing a brief introduction on communication proficiencies
- Developed skills for doing analyses and survey of data/MIS for the energy sector along with skills to monitor the progress of the ongoing projects
- Developed skills to make project proposals, report writing and presentation making as per the requirements and guidelines of MEW
- Capacity development in understanding of feasibility study of Solar and Wind projects
- Capacity development in understanding of stakeholder behavior during various phases of Project

5 Recommendation

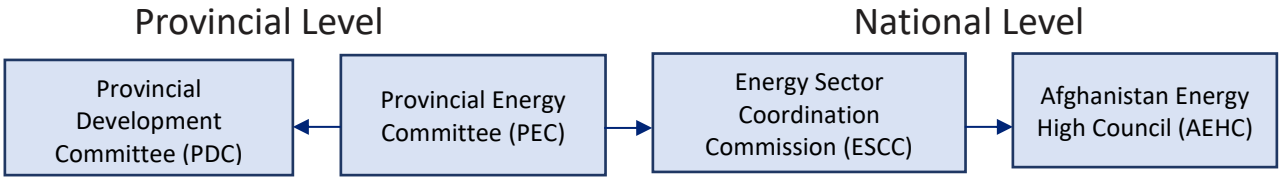
The PEC's are the overall energy coordination structure of national government at the Provincial level and therefore assume significant importance in terms of coordination agency at provincial level. All the MEW energy sector policies are to be implemented at provincial level and therefore capacity building of members of PEC in terms of energy sector is very critical. During the various interaction we had with PEC members, MEW and GIZ team it is realized that PEC has following challenges:

- Creation of a clear organizational structure for PEC
- Given the limited presence of MEW in the provinces, the current structure would require external funding support
- Currently 5 Regional hubs of PEC covers 4-5 provinces each, however it is recommended to create a PEC team for each province

In order to overcome the above challenges and make PEC sustainable, we recommend the following sustainability plan:

Takeover role of PEC at Provincial level:

The institutional set-up of PEC is such that the Ministries of MEW and MRRD delegate more authority and responsibility to provincial government in Energy sector. The current set-up of PEC is explained below:



As keen be inferred from above, PEC takes charge of all energy related issues in provincial offices in consultation with national and provincial governments. However in order to coordinate with all the provinces of the country, PEC need to be present in each provinces and coordinate with local government. The physical presence of PEC in the provinces is strengthening the development of MEW's energy related projects in provinces.

The Independent Directorate of Local Governance (IDLG) is the agency having outreach at local governance level in all the provinces of Afghanistan. The mandate and responsibilities of IDLG are:

Improving local governance to ensure access to development, stability and security:

i. Providing good governance in the local level
ii. Supporting local administration
iii. Ensuring public participation in the decision-making process
iv. Key tasks of IDLG has been identified within four key sections:

- Policymaking: **developing sub-national governance policy and revision of laws, regulations and bylaws** in accordance with the policy
- Institutional development: supporting institutions, **capacity building and supporting sub- national administrations**
- Inclusive Governance: **supporting participation of stakeholders and citizens in the sub-national governance processes**
- Supporting: facilitating **implementation of national programs through sub-national governance entities**

Though IDLG's main mandate is improving citizen participation and governance process and implementing national governance program, but given the energy deficit across the country, ability to contribute to energy planning and supply would be a key enabler to support overall objective of IDLG.

IDLG has a strong presence in the local government level is.

- **34 provincial governor's offices**
- **376 district governor's offices**
- **33 provincial municipalities** (excluding Kabul municipality)
- **34 provincial councils**

IDLG is represented across the entire Afghanistan through Sectoral Services Directorate (SSD). SSD works directly under the Provincial Governors and hence have access to the highest level of decision making in the provinces and therefore we believe this would be an appropriate agency to take over the role of PEC.

Transition Plan:

With the infusion of billions of dollars in international assistance, the economy of Afghanistan has made significant improvement. The infrastructure of any country is the backbone of its economy, Electricity being one of the key infrastructure element plays an important role in the development of Afghanistan. As per the power sector strategy of Afghanistan, Energy is Afghanistan's economy hope for growth. The assured availability of power at affordable price to the citizens of Afghanistan will guarantee improve living standards and promote economic growth.

The development efforts at the provincial level will lead to overall growth of the country. The GoIRA has taken various steps in developing the provincial government and one such step is formulation of IDLG whose key responsibility is supporting the Provincial Councils responsible for supporting the local governance.

IDLG having strong presence in most of the provinces of Afghanistan through its various directorates and councils which are better equipped to task the PEC role and responsibilities.

Transition Plan of IDLG to engage in PEC responsibility is detailed below:

- Create a strong buy in at IDLG for the national energy plan and build a relationship between MEW and IDLG.

a. Create a MEW- GIZ desk at IDLG for nine (09) months (Calendar year 2018) manned by MEW staff and supported by GIZ through its appointed local consultant. The desk will support in identification of IDLG roles and responsibilities covering Energy sector work. It will identify the work areas of IDLG wherein Energy is part of their work area. The desk will strategize the plan for transfer of Energy planning responsibilities at provincial level to SSDs of IDLG.

Roles and Responsibilities of Desk:

i. Adopting and dissemination of policies in the Energy sector and coordination with various departments/ ministries thereof.

ii. Assist in Energy sector planning activities and Renewable Energy projects development at Provincial level.

iii. Provide information, training, and technical assistance on matters relating to power generation, transmission & distribution system network at the provincial level;

iv. Research, development and technical assistance relating to Energy sector.

v. Providing guides and training in energy schemes and issues relating to power supply/development schemes/ programmes.

vi. All matters concerning energy conservation and energy efficiency pertaining to Energy Sector.

Manpower of Desk:

The consultants to be hired for atleast 36 weeks in order to provide hand holding support to the desk. The proposed team to be hired for the GIZ-IDLG desk is provided below:

Expert	Qualification	Experience	Total week	Total Onsite week
Transition Team Leader	Master's in Business Administration or other relevant degrees such as engineering or economics	A minimum of 5 years of experience of working with electricity utility in increasingly responsible senior management positions.	36	09-12
Transition Project Management Expert (national expert)	Degree in Engineering	A minimum of 3 years of experience of working with power sector projects	36	36

Database Administrator cum Help Desk Expert (national expert)	Degree in Engineering	A minimum of 1 years of experience of working with power sector projects	36	36

Role of Consultants:

i. Develop a mechanism to facilitate dialogue among key agencies such as SSD and IDLG, MEW to resolve the issues that inhibit working of the Provincial committee.

ii. Develop and introduce a communication mechanism to facilitate coordination between PECs/MEW, SSD and IDLG.

iii. Handholding and provide support for smooth transition of operation from GIZ to the IDLG- MEW desk. Also, develop a joint training plan for PEC, SSD and IDLG in accordance with MEW's energy policies.

iv. Creating a workflow for future role of SSD's of IDLG in Energy planning and RE project development across provinces.

v. Prepare a transition road map of handing over the responsibilities of Provincial Energy planning to IDLG, PEC and SSD.

- GIZ to handover the desk to MEW as per the transition plan and a 3-month need based hand-holding support to MEW provided by GIZ for the successful transition. The transition plan is depicted below:

Task	Who's Responsible?	When Is It Due?
Coordinate transition planning meeting	Transition Team Leader, Transition Project Management Expert (national expert), IDLG & MEW	Month 1
Distribute project Initiation Plan	Database Administrator cum Help Desk Expert (national expert)	Month 1
Conduct transition planning meeting	Transition Team Leader, Transition Project Management Expert (national expert), Database Administrator cum Help Desk Expert (national expert) IDLG & MEW	Month 1
Review development project schedule	Transition Team Leader, Transition Project Management Expert (national expert)	Month 2

Develop matrix of required resources/skills	Transition Team Leader, Database Administrator cum Help Desk Expert (national expert) & IDLG	Month 2
Conduct gap analysis	Transition Team Leader, Transition Project Management Expert (national expert) & IDLG	Month 3
Identify project activities to be completed before transition can start	Transition Team Leader, Transition Project Management Expert (national expert), Database Administrator cum Help Desk Expert (national expert) IDLG & MEW	Month 3
Determine timeline & Transition milestones	Transition Team Leader, Transition Project Management Expert (national expert),IDLG & MEW	Month 3
Determine actual training needed, based on gap analysis	Transition Team Leader, Transition Project Management Expert (national expert)	Month 4 to 9
Determine measurable tasks to validate that knowledge transfer is acceptable and initiate process to achieve the same	Transition Team Leader, Transition Project Management Expert (national expert), & IDLG	Month 4 to 9
Hand holding support	Transition Team Leader, Transition Project Management Expert (national expert), Database Administrator cum Help Desk Expert (national expert)	Month 6 to 9

6 Annexures

Annexure-1

2.9 MW Solar Power Project
Mawlana Jalaluddin Balkhi International Airport
Balkh Province, Afghanistan

Date May 2, 2018

H.E Mr. Mohammad Gul Khulmi

Energy Sector Deputy Minister

Ministry of Energy and Water

Subject: 2.9 MW Solar Power Plant Project in Balkh International Airport

Dear Sir,

Kindly find enclosed proposal for 2.9 MW Solar power project at airport of Balkh province for the donor receives is send to the supreme.

Brief details about the project and its purpose are attached herein after.

Yours faithfully,

Zabiullah Akhtari

Head of Provincial Energy Committee (PEC)

Balkh, Province

Zabiullah.akhtari@yahoo.com

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1. Executive Summary

A reconstructed terminal at the Maulana Jalaluddin Balkhi International Airport in Mazar-i-Sharif, the capital of northern Balkh province, was inaugurated in 2014. The terminal, a joint venture of Germany and the United Arab Emirates (UAE), cost €60 million and took three years to complete. Germany contributed €48 million and the UAE €12 million to the project that can accommodate 1,000 passengers a day. The airport boosts trade in northern Afghanistan, particularly in Mazar-i-Sharif. Flights from the airport are operated to Iran, Uzbekistan and Turkey in addition to domestic flights. The airport matches all international standards and has a key role in connecting northern Afghanistan with the rest of the world.

As the airport provides great services its countrymen and foreigners it also requires a lot of power to function. Afghanistan being a country deprived of readily available non-renewable resources, relies largely on the non-renewable energy generation. Adding a 2.9 MW Solar power project at airport of Balkh province will not only suffice the airports own power needs but will soon be able to supply power to nearby big and small settlements in the coming time. Afghanistan has great potential to harness the solar energy due to its geographical and dry and sunny climatic conditions.

2. Introduction

Balkh province is located in North of Afghanistan at 36°4'33"North and 67°07'33"Eeast. Balkh province has International border with Uzbekistan and neighbor with Kunduz, Jawzjan, Sare Pul and Samangan provinces. Balkh province has over 2.2 million population in 14 districts including Mazar and Hairaton cities. Due to central and strategic location, Balkh has the potential to turn to an intersection of Asia and Central Asia as business hub among Afghanistan, Uzbekistan, Central Asia particularly China, Iran and Russia. Today Balkh is considered as second gateway to Central Asia. The Hairaton border (Friendship Bridge) connects Balkh with Uzbekistan and Central Asia, particularly China. Balkh has a feasible potential to generate 4,211 MW from its own renewable energy sources. This position Balkh as hub of energy source in Afghanistan and gives the assurance that Balkh has a good outlook to become a self-reliance province under the administration of Government of Islamic Republic of Afghanistan (GIRoA).

The Mawlana Jalaluddin Mohmmad Balkh 2.9 MW Project is located at 11th district of Balkh province of Afghanistan. The overall capacity of the plant is estimated to be 40 MW with a total area of 750,000 Square meter of land (300X2, 500 Sq.). The direct beneficiary of the project is Balkh Airport, possibly ISAF and Local community through DABS or private sector.

The project will be put on bidding for private sector investment. The overall cost of the 2.9 MW of the project is estimated USD 4,778,000 from which 50% of the project cost will be granted by Salwak Government and the remaining amount is expected to be invested by private sector through installments. A PPP or PPA need to be initiated by MEW, Private sector or DABS

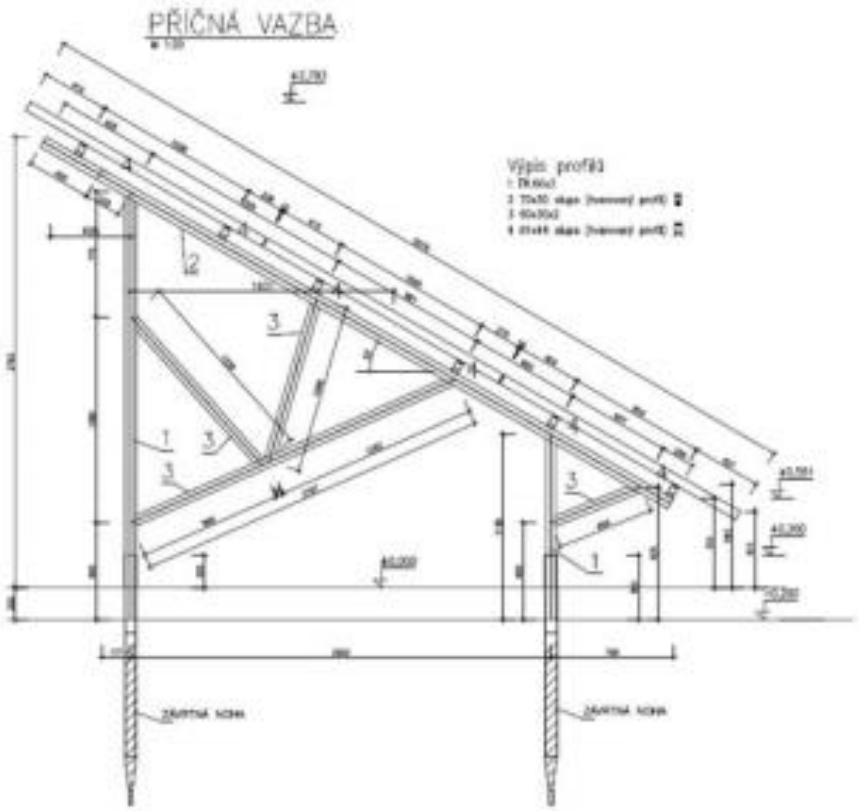
3. Project Implementation

The project will be implemented in Mawlana Jalaluddin Mohammad Balkh International Airport in district 11th of Balkh province. The main stakeholders of the project is Balkh International Airport, Ministry of Energy and Water (MEW), Ministry of Finance (MoF), Government of Salwak, Provincial Energy Committee (PEC) and private sector.

The Government of Salwak will cover 50% of the project cost as grant and the remaining cost of the project is expected to be invested by private sector. Government of Salwak will pay 85% of the project cost and private sector needs to pay 15% upfront. The remaining 35% of government or private sector contribution can be paid over period of 3 – 15 years.

The overall project is design as follow:

1. **Project Scope:**
   - Project and design with geo-physical survey for PV plant 2.9 MWp
   - Supply and installation of support frames for 10740 pcs of 270Wp PV panels
   - Supply and installation of 10740 pcs PV panels type polycrystalline 270Wp
   - Supply and installation of the main MV kiosk connected to the Grid by MV cable (underground) with MV protection units, utility measurement and 50kVA own consumption Transformer.
   - Supply and installation of 3 pcs MV/LV kiosk with Transformer 1000 kVA, 0,42/22kV and LV switchboard
   - Supply and installation of LV joining switchboards (decentralized solution)
   - Supply and installation of decentralized photovoltaic inverters 116 pcs x 25kW
   - SCADA and monitoring system
   - Supporting drilling structures



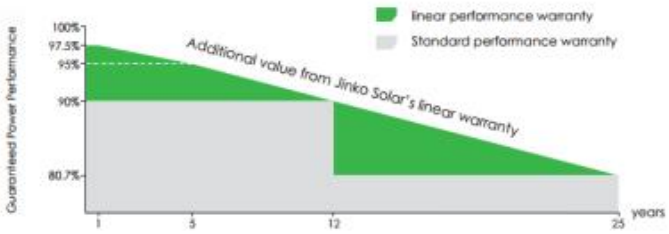
The main component of MV kiosk are:

- 1-piece Concrete kiosk including: internal wiring, sealing system for cable entries, aluminium doors and covers for ventilation openings, internal grounding, lightning, external synthetic facade.
- 1-piece MV switchboard with SF6 insolation (6 cubicles) including: switchgear with protection, measurement, 3 x switchgear with protection, Fuse disconnector for own consumption
- 1-piece Transformer 50kVA - 22/0,42KV oil type
- 1-piece LV swb – own consumption.
- 1-piece LV swb – Utility measurement

The local LV/MV kiosks:

- 3-piece Concrete kiosk including internal wiring, sealing system for cable entries, aluminium doors and covers for ventilation openings, internal grounding, lightning, external synthetic facade.
- 3-piece MV switchboard with SF6 insolation (2 cubicles) including: switchgear with protection, Fuse disconnector for Transformer
- Transformer 1000kVA, 22/0.4 kV, ECO 3-piece
- LV swb RH1-1 3-piece
- 30-piece LV joining switchboards (decentralized solution)

- PV panels type POLY CRYSTALLINE MODULE power of 270 Wp 10741 pieces



- Module Efficiency STC (%) 16.50%
- Decentral inverters 50 kW 58 pcs

Indication price without VAT:

The exact price will be specified after the project and design validation by investor

Indicative price offer without VAT for 2.9 MWp Solar		
I	4,778,000 USD	

Price offer not includes:

- VAT, Customs and local customs fee
- Delivery and insurance, Security of material and people
- Legislative approvals and local inspections
- CCTV cam system for monitoring and securities
- MV Grid connection / underground cabling 2000 m (app. 190-200 € / 1 m) + MV d-switch on pole
- Basic fencing of PV plot - area for 2,9MWp eq. to 7 ha
- Utility remote control of the main connection point
- Maintenance and services (can be provided by separate offer)
- Delivery terms: according to EPC contract and agreed conditions
- Validity of the offer: 3 months
- Payment condition: on the basis of EPC contract and bank guarantees
- Warranty: 24 months from installation, can be prolonged after O&M contract 10 years for PV panels

2. Project Quality Management

The various technical aspects of the project which need to be analysed / control are

- Engineering, Quality Testing, Quality Control
- Detailed Technical Inspection, Commissioning
- Regular Physical as well as online Inspection of Plant at regular intervals
- operations & Maintenance and Performance Analysis

4. Conclusion

Subject to socio technical viability of the proposal, it is requested that necessary approvals be given for the development of the project.

5. Follow up Action and Recommendations

- Detailed study of the project along with techno economic viability of the project
- Requisition for allocation of the Fund through the Ministry subject to viability of the report
- Request to MEW for Grant of permission for commission of the project
- Legislative approvals required by the various ministry
- Synchronizing of the project with the existing substation and the available transmission line
- Coordinating with DABS for signing of Power Purchase Agreement
- arranging for proper security and insurance of the project
- Requisition for manpower and other necessary technical support

PROPOSAL FOR 250 kW SOLAR POWER PLANT FOR FAIZABAD AIRPORT, BADAKHSHAN PROVINCE, FGHANISTAN

Figure of Faizabad Airport, Badakhshan Province

Eng. Shahnaz Kohistani
Solar Manager-Renewable Energy Department
Ministry of Energy and Water, Kabul, Afghanistan
Date: April 30, 2018

To:

Government of U.S.A, USA Embassy-Kabul

Great Massoud Road, Wazir Akbar Khan,
Kabul, Afghanistan

Telephone: (+93) 700-10-8001; Fax: (+93) 700-108-564
Website: af.usembassy.gov

Date: April 30, 2018

Subject: Financial support for 250 kW solar power plant at Faizabad airport, Badakhshan province, Afghanistan.

Dear Sir,

Afghanistan's consumption of electricity is one of the lowest in the world. The per capita consumption averages 176 kWh per year1, which is significantly less than the South Asia average of 707 kWh per capita per year2, most of the people have high hope from Government of Afghanistan (GoA) to supply electricity.

Lack of access to stable power energy is the main public problem of Afghanistan people specially habitation of Badakhshan province, the province which is one of the 34 provinces of Afghanistan, located in the farthest northeastern part of the country between Tajikistan and northern Pakistan and has area around 44,836 km2 . It shares a 56.5-mile (91 km) border with China. It is part of a broader historical Badakhshan region. The province contains 28 districts, over 1,200 villages, and approximately 1,400,000 people. Faizabad is as the provincial capital. Badakhshan has a good potential of renewable energy such solar (solar radiation 5 kwh/m2/day, and 3,736 MW capacity solar energy feasible area), wind (wind area1428m2, wind energy potential 3314 MW, 331 MW feasible wind energy capacity) and mini and micro hydro power (total capacity surveyed projects 7,065 KW)3 etc.

Faizabad airport is very important for connection point of Kabul and Badakhshan, the terminal and building of airport has not connected to electrical public grid of Faizabad, in present generators are run to meet its demand, which is a very big expense and causing environmental problems. There are daily fuel expenses, repairs on the generators, engine oil costs. Therefore, the PV solar system is a good option for supplying airport demands.

The proposal of the 250 kW solar power plant for Faizabad airport project is planned to generate electricity from solar sources and project cost is 1 million US dollar we kindly request Government of United States of America for funding of this vital project.

We thanks our friendly country USA which has undertaken projects virtually in all parts of Afghanistan, in a wide range of sectors especially in power sector.

Yours faithfully,

Eng. Shahnaz Kohistani

Solar Manager of Renewable Energy Department

Ministry of Energy and Water, Kabul, Afghanistan

[1] Reference National Energy Policy
[2] Reference: GIZ survey database
[3] Reference: RED Maps of MEW

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1. Executive Summary:

A large share of the Afghan population, especially residents of those provinces which are not connected to national grid still has no access to electricity even people who lives in capitals of these provinces has no electricity for instance Badakhshan province. In Badakhshan province in present the requirement electricity have been generating from diesel generators, small solar PV and some micro hydro sources. People face with a lot of problems due to absent of electricity in major parts of Badakhshan province one of those area is airport of Faizabad.

Faizabad airport is very important for connection point of Kabul and Badakhshan, the terminal and building of airport has not connected to electrical public grid of Faizabad, in present generators are run to meet its demand, which is a very big expense. There are daily fuel expenses, repairs on the generators, engine oil costs therefore, the PV solar system is a good option for supplying airport demands.

Therefore, the proposal of the 250 kW solar power plant for Faizabad airport project is planned to generate electricity from solar sources and project cost is 1 million US dollar we kindly request Government of United States of America for funding of this vital project.

2. Introduction:

Lack of access to electricity is the main problems of Afghanistan people, especially who lives in remote areas. On the other hand people are very needy and they are suffering from darkness, poverty, illiteracy and they don't have access to modern life facilities. So that all problems gather and provide a situation for trees cutting, use of traditional oils lamp, burning of animal's dung, woods, gas, collier and other plants excrement.

Additionally, a large share of the Afghan population, especially those provinces which are not connected to national grid still has no access to electricity even people who lives in capitals of these provinces has no electricity for instance Badakhshan province. To overcome these issues, the government of Afghanistan aims to increase domestic electricity generation by 2032 with a share of 5000 MW of renewable energy, equivalent to 95% of the electricity supply in that year.

Therefor using solar energy and changing it to electricity, so that power photovoltaic cells is a modern technology which is become common around the world. Also, global attention is on reduction of CO2 emission by focusing on renewable energy as good potential replacement for fossils fuels.

The purpose of 250 kW solar power plant for Faizabad airport project is aimed to bring electricity in Faizabad airport. Faizabad airport is located at 7 district of Faizabad capital of Badakhshan province, which is near to Kokcha River. The airport have 3 separate buildings, staffs works in two shafts. At present the requirement electricity have been generating from diesel generators, because the airport is not connected to public electricity gird of Faizabad. The electricity which generated by generators is very big expensive. There are daily fuel expenses, repairs on the generators, engine oil costs, and the local staff cannot always purchase the fuel on time. Purpose of using the electricity in airport are using for computer, printer and other electrical equipment's of offices, water pumps, lighting system of terminals and flight lines, therefore, the PV solar system is a good option for supplying airport demands.

By implementation of this project staffs of airport will have access to clean energy which is friendly with environment access to collective information about flight schedule and drinking water. The solar power project will be promote the energy efficiency and diversify the Renewable energy generation in the target area.

The power which generated from this project will be off grid. Power will be supply mainly to airport. The direct beneficiaries of this project will be those staffs who works in airport and the indirect beneficiaries of this project will be governmental authorities.

3. Technical and Financial section of the Project:

3.1. Technical Information:

The Fizabad airport is located in area that is suitable for installation of solar panels, GPS coordination N=37007.251 and E=70031.033. Base of that we planned 250 kW solar power plant for supply electricity for the airport which required around 3000 m2 area. This area is available inside of airport and type of property is belong to public. There are no shading on the area which the panel will be install. The maximum wind speed is 3 m/sec, number of sun hours per day is 8 to 9 hours, solar radiation 5 kwh/m2/day and annul ambient temperature (Coldest and hottest) is 130 to 370.

No	Description	Quantity	Wattage (W)	Total Wattages(W)
1	LED Bulb Lighting	591	12	7092
2	Computer desktop and server	10	400	4000
3	Printer	5	650	3250
4	Laptop	5	100	500
5	Scanner	3	500	1500
6	Photocopy	3	1500	4500
7	Electric Fan	10	60	600
8	Refrigerator	4	113	452
9	Air- conditioner	5	1350	6750
10	LED Area lights	50	100	5000
11	Television LCD	3	150	450
12	Energy efficient Boiler	5	1000	5000
13	UPS	5	500	2500
14	Server UPS	1	2000	2000
15	Fight Schedule LCD Monitor	3	500	1500
16	Internet swishes	2	500	1000
17	Lockage Scanner	2	1500	3000
18	Full body scanner	2	1000	2000
19	Convers belt	1	2000	2000
20	Security camera	50	100	5000
21	Water pumps	2	2500	5000
Total				**125200**

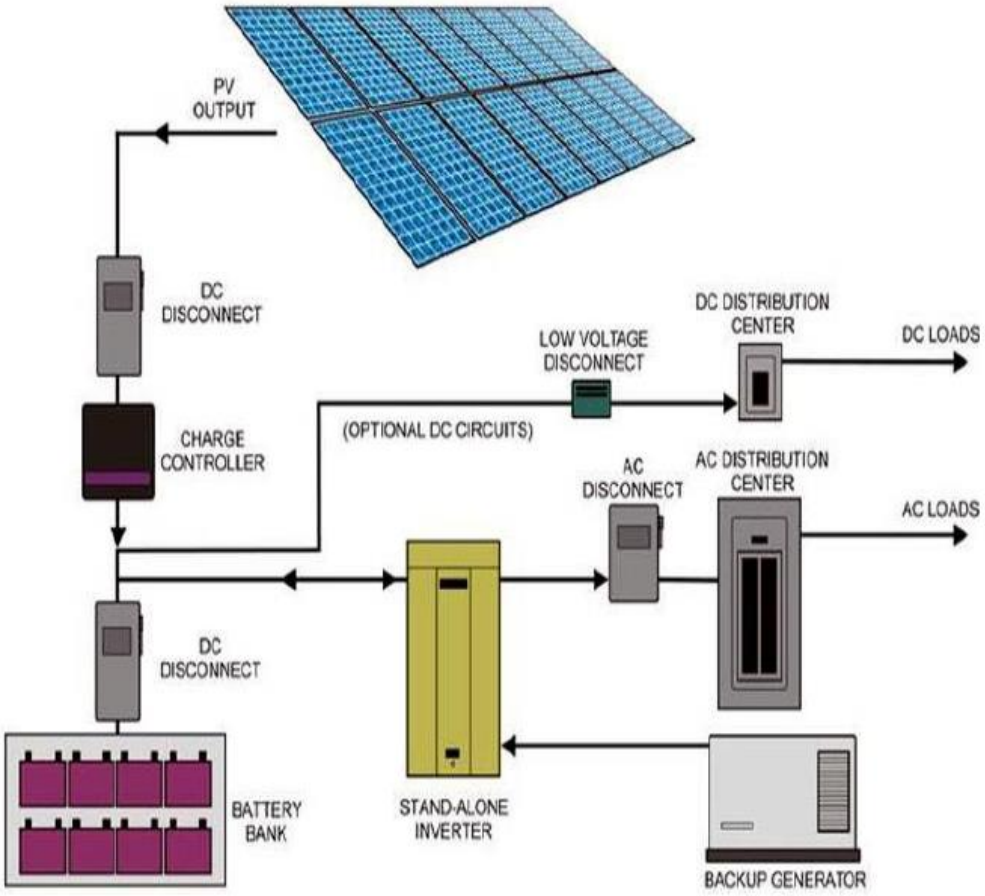
3.2. Technical specification Table:

Functional Guarantee	Minimum (or Maximum, as appropriate) Requirement
1.solar panel	Minimum 10 years not less than 90 % efficiency and 25 years not less 80% efficiency
2.inverter	Minimum 10 years
3.support structures	Minimum 20 years
4.Batteries	Minimum 10 years
5.other equipment's of the projects	According to the IEC standards which are mentioned in the TOR.
6. The solar park out put	Contractor must grantee for production of 5.5 MW AC output,
Battery Cell Technology	The lithium ion batteries that 80 % Depth of Discharge.
Fire safety	IEC 62619, UL 1973
Operating temperature	-30°C to +50°C
Warranty	10 to 15 years (depending of cycles and DOC)

4. Electrical equipment's Conclusions:

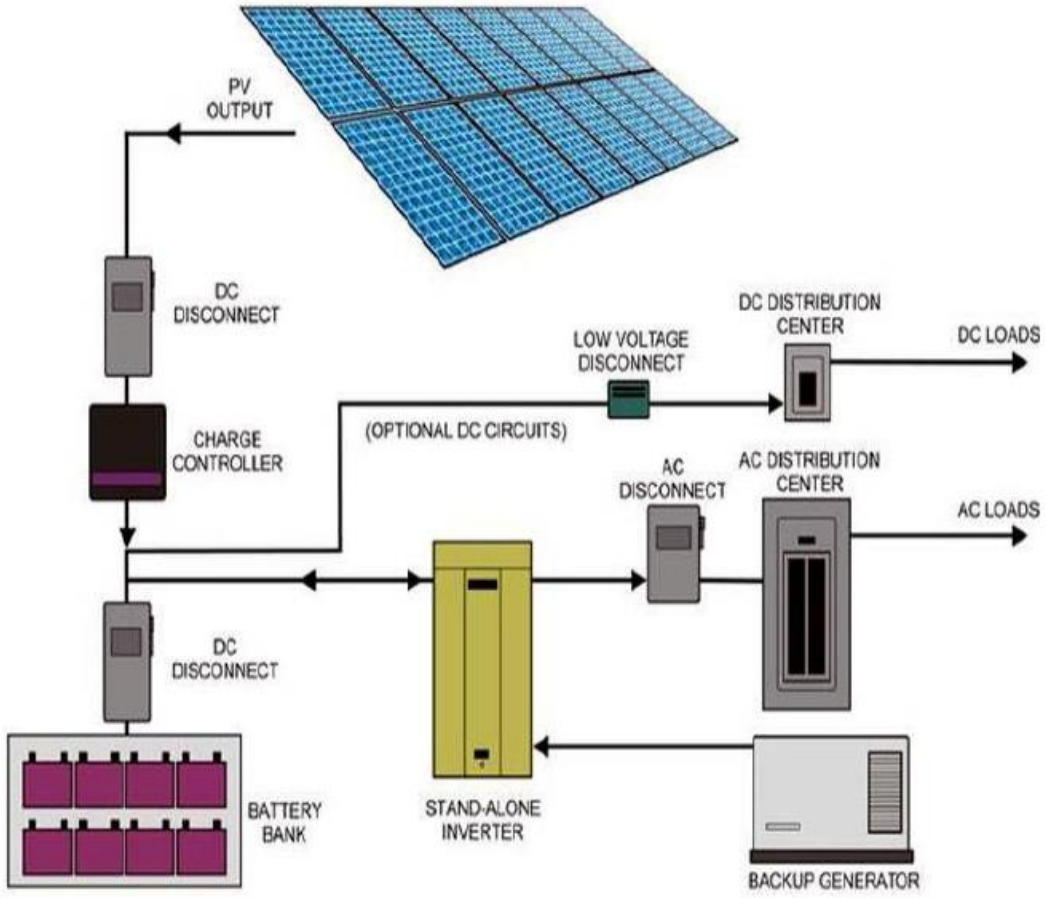
Considering the project availability of solar resources and having 300 sunny days in Badakhshan therefore, the PV solar system is a good option for supplying airport demands, also global attention is on reduction of CO2 emission by focusing on renewable energy as good potential replacement for fossils fuels.

250 kW solar power plant for Faizabad airport project will provide facility for airport staff and people who are traveling from this airport.



5. Recommendations

We hope that this vital project will be fund by government of USA, which will cost around 1 million US dollars and the impact of project is very high and it will bring facility for 5000 people yearly.



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400KW MHP PROJECT IN WARSAJ DISTRICT, TAKHAR PROVINCE, AFGHANISTAN

Safiullah Momand
Renewable Energy Department Kunduz Zone
Logar Water Regulation Officer
Ministry of Energy and Water.
Date: 1/5/2018

To

Ministry Energy and Water

Kabul, Afghanistan

Dated: 30.4.2018

Subject: 400 KW Warsaj Micro Hydro Power

Dear Sir,

The purpose of this project is to construct a 400 Kw Micro Hydro Power Project and it will be constructed on the Warsaj river. The water availability is throughout the year and the river is perennial.

The river supports around 200 homes and the power generated through this project will benefit them. As of now the source of power for the area is through Diesel Gensets. The cost of procuring the power through gensets is around 45$g/kwh. We expect once power is generated through MHP the power procurement rate will come down substantially.

Yours faithfully,

Safiullah momand
RED KUNDUZ ZONE
Logar Water regulation officer
Ministry of energy and water.
Date: 1/5/2018

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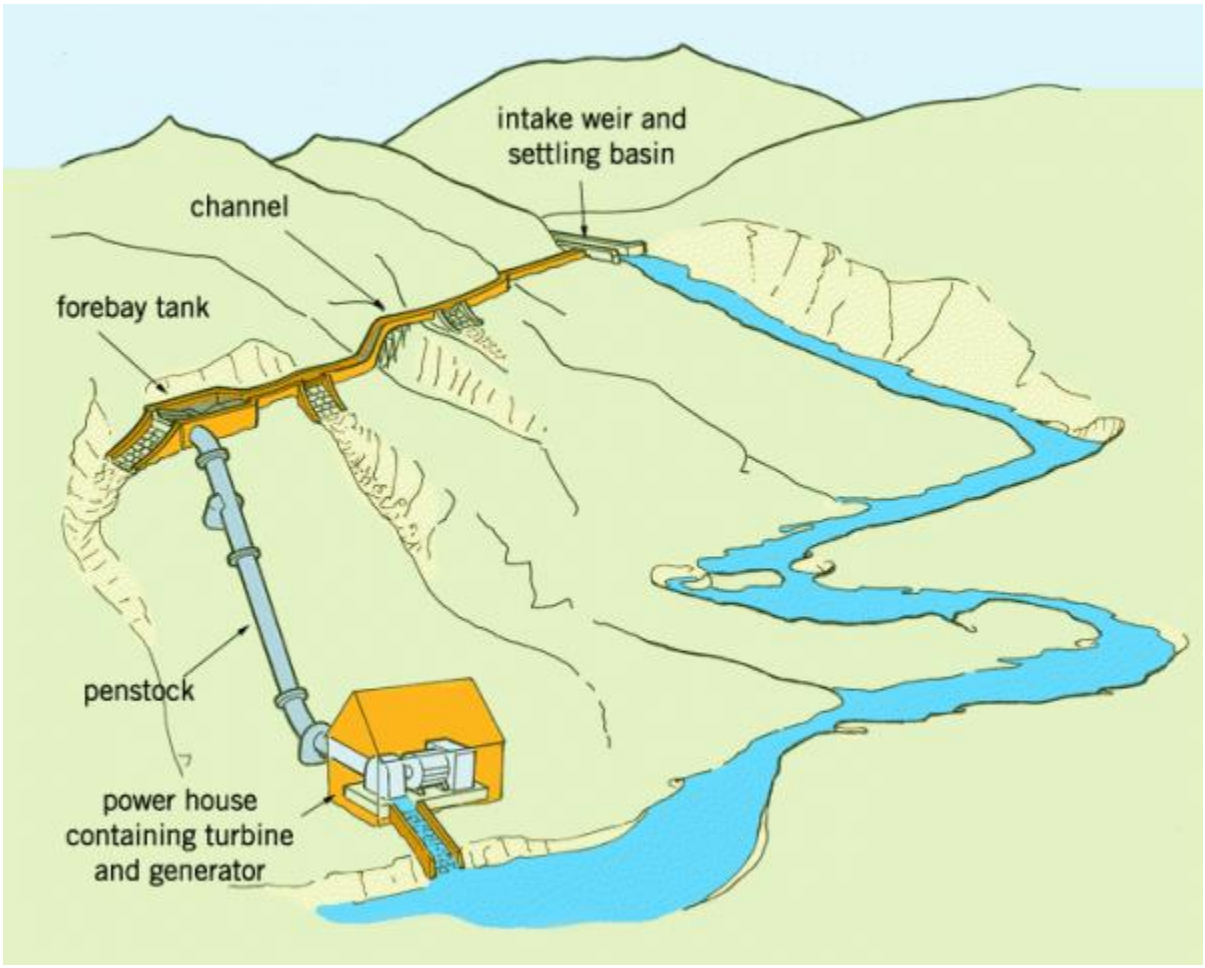
1. Executive Summary

Micro-hydro power is the small-scale harnessing of energy from falling water, such as steep mountain rivers. Using this renewable, indigenous, non-polluting resource, micro-hydro plants can generate power for homes, hospitals, schools and workshops. Practical Action promotes small-scale hydro schemes that generate up to 500 kilowatts of power. The micro-hydro power station, which converts the energy of flowing water into electricity, provides poor communities in rural areas with an affordable, easy to maintain and long-term solution to their energy needs.

"Run of the river" systems do not require a dam or storage facility to be constructed. Instead they divert water from the stream or river, channel it in to a valley and drop it in to a turbine via a pipeline called a penstock.

The turbine drives a generator that provides the electricity to the local community. By not requiring an expensive dam for water storage, run-of-the-river systems are a low-cost way to produce power. They also avoid the damaging environmental and social effects that larger hydroelectric schemes cause, including a risk of flooding.

Water from the river is channeled through a settling basin, which helps to remove sediment that could harm the turbine. The water then flows into the Fore bay Tank where it is directed downhill through a pipe called a penstock. When the water reaches the bottom, it drives a specially designed turbine to produce the electricity.



2. Introduction

At present there is no commercial electricity and electrical grid in the Warsaj region. The civilian people that are more than 1000 are divested from electric. By development of this project all homes and people will get benefit from supply of electricity. The Warsaj River have enough water flow (1.5 cumecs) in this area to develop the envidaged 400 KW Micro Hydro Power Project, which is essential to serve these people.

a. The purpose of this project:

- To electrify the all homes and shops and social places in the area
- To support the economic system of the district
- 2000 people will be benefited from this project
- All civilian people based around the project will get benefit

b. Details of the project

Name:	**400Kw Warsaj Micro Hydro Power Project**
Location:	Takhar province
District:	Warsaj
Region:	Boostansar
River:	Warsaj
Discharge of water:	1.5 Cumecs
Length:	5 km
Coordinate:	N=36 11 .866 E= 70 05 .056 (Power House)
Power House:	1898m

3. Technical details

Length of weir:	12m
Width of weir:	3m
Height of weir:	33m
Discharge:	1.5m³/sec
Capacity:	(2 x 200 KW) 400 KW
Voltage of line:	20 kv
Length of line:	12 km

4. Financial Details (USD $)

Primary survey and meeting the area	3500- $
The travel	3500 -$
Workmen	200000-$
Design of structure engineering	100000-$
Station system, dam, canal and power house	550000-$
Electrical material, turbine, generator, stator and rotor	350000-$
Capacity building for staffs	100000-$
Transportation	180000-$
Additional costs	100000-$
Monitoring costs	50000-$
Official costs	90000-$
Total cost	1790000$

5. Conclusions

5.1. Environmental Impacts:

Unlike traditional power stations that use fossil fuels, micro-hydro generators have practically no effect on the environment. And because they don't depend on dams to store and direct water, they're also better for the environment than large-scale hydro-electric stations.

In fact, by reducing the need to cut down trees for firewood and increasing farming efficiency, micro-hydro power has a positive effect on the local environment.

5.2. Multipurpose uses:

Micro-hydro power can also be supplied to villages via portable rechargeable batteries. People can use these convenient sources of electricity to fuel anything from workshop machines to domestic lighting – and there are no expensive connection costs. The batteries are charged at a station in the village, thus providing the local community with a clean, renewable source of power.

For industrial use, the output from the turbine shaft can be used directly as mechanical power, as opposed to converting it into electricity via a generator or batteries. This is suitable for agro-processing activities such as milling, oil extraction and carpentry.

Micro-hydro schemes are owned and operated by the communities they serve, with any maintenance carried out by skilled members of that community. So they provide employment in themselves, as well as providing the power to re-energize entire communities.

6. Recommendations

Afghanistan has a relatively good volume of water recourse more than 80 percent of the country's water resources come from snow melt in Hindu kush. Canal irrigation is by far the most commonly-used irrigation method in Afghanistan as canals irrigate nearly 1.9 million ha of land

Given the current scenario of the country, installing Micro Hydro Power system is a win-win situation for the people as well as Government of Afghanistan as helps in producing electricity from the already available water resources which further helps the locals to use it on multiple levels.

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SHAHR-E-BUZURG MINI HYDROPOWER PLANT (400KW)

Mohammad Rafi Bahman
Kokcha River Sub Basin Agency
Ministry of Energy and Water
May 1, 2018

To

H.E Ambassador

Embassy of Republic of India

Sedarat square, Str. # 4th, Kabul-Afghanistan

Date: May 1, 2018

Subject: Shahr-e-Buzurg Mini Hydropower Plant

Dear Sir,

The Provincial Energy Committee of Badakshan province is extended its cooperation with Government of India. We appreciate the continue support of India to Afghan Government in different development sector.

The Badakshan province is one the provinces that its population is suffering from lack of electricity. Only 10% of the population has access to electricity the remaining 90% of the population is suffering.

We kindly request the Government of India on its support to Badakhshan province for funding the 400 KW mini hydropower plan in Shahr-e-Buzurg district of Badakhshan province.

Yours faithfully,

Mohammad Rafi Bahman
Kokcha River Sub Basin Agency
Ministry of Energy & Water

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1. Executive Summary

The province is rich in fresh water sources, (about 23%) of the country's water resource is located in Badakhshan. The estimated hydro-electricity generation potential in the province is about 930 MW (only large power plants). Revenue collection by exporting the electricity to another provinces is possible. 9.5 MW (100KW-2MW) available new small hydropower potential in districts centers of Badakhshan province which the project below is one of these potentials. The micro-hydro power station, which converts the energy of flowing water into electricity, provides poor communities in rural areas with an affordable, easy to maintain and long-term solution to their energy needs.

Afghanistan's Ministry of Energy and Water aims to install 500 MW of PV plants by 2020. The country's renewable energy policy is targeting 4 to 5 GW of new renewable energy capacity by 2030.

Government recognizes the importance of economic growth in reducing poverty and averting future conflicts. In Afghanistan National Development Strategy (ANDS), the Government emphasized the importance of "enhancing access to cost-effective and uninterrupted power". Specifically, the Government's draft Power Sector Strategy recognized the importance of enhancing rural energy availability and imposed an ambitious target of delivering 100 MW to electrify 25 small towns and rural villages through micro hydropower and decentralized standalone systems.

2. Introduction

Project Name:	**Shahr-e-Buzurg mini hydropower plant**
Location:	Afghanistan, Badakhshan province, Shahr-e-Buzurg district
Supply Area:	Dawang village
Water source:	Dawang river, minimum flow 0.7 m3/s
Accessibility:	Good via off road throughout the year, distance from Faizabad 116 km
Security Condition:	Good
Environmental:	**Good**

2.1. Project Snapshot

Project Name: Shahr-e-Buzurg Mini Hydropower Plant

Capacity: 400KW

Location: Dawang village, Shahr-e-Buzurg, Badakhshan, Afghanistan

GPS: N: 37 18 818 E: 070 10 013 (Power House)

Elevation: 1753 m (Power House); 1823 m (Intake Site)

Water source: Dawang River minimum flow 0.7 m3/sec

Shahr-e-Buzurg is a district located in south east of Badakhshan province with 80,000 population and 116 KM away from Faizabad district of Badakhshan province. The population living there do not have access to electricity.

This project will supply the electric power to 9,000 populations out of 80,000 the whole population living in the district. This project will cover 9 villages, 70 shops, 20 Masjid, 5 schools, 3 offices, 3 governmental offices, 2 health facilities (clinic), 2 veterinary clinic and a number of workshops.

As this district is very away from Faizabad and also this district is not connected to the national grid and also there is no any other type of power plant, so the clinics, households and another public departments need to the electric power which some of them supply this demand by fusel fuel which is not an environmental friendly option.

Why we did not choose an MHP for the whole 80,000 population:

- The villages are very far away from each other
- The hydro potential of river is maximum 400KW and it cannot suffice the whole population in the district
- The 9 villages covered by this MHP are close with each other
- These villages are located at the district center, so most of the governmental organizations, clinics, schools, Masjids and another public departments are located in this area
- It has a good environmental affect
- A part of water can be used for power supply and the rest will flow through the river for fish migration

Note: The data mentioned above has been sourced from Kokcha River Sub Basin Agency by contribution of GIZ-ESRA Program in Badakhshan province

2.2. Project Financial

Estimated cost of the project: 3.1 MUS$; 7.750 US$/KW; 344 US$/person. 30 % of the project cost will be paid by the villagers as in-kind contribution and the remaining 70 % o will be received from the embassy of India.

3. Project Details

3.1. Technical Description:

3.1.1. Weir / Dam (Civil / Structural):

- The run-off the river project comprises a 63-meter-wide weir of 3 m height.
- The water is conveyed via a 2.95 KM long head-race canal to the fore-bay with a gross head of 70 m and a nominal discharge 0.7 m3/s the capacity is about 400KW.

3.1.2. Turbine (electro-mechanical)

Turbine capacity: 2x 200 KW (400 KW)

Rated Head: 70 m

Rated Flow: 0.7 m3/sec

Turbine Type: Francis

3.1.3. Power Evacuation (Electrical):

The power is transmitted via a 23 KM long 20 KV transmission line and distributed via 0.4 kv network. Houses are connected via service cable and equipped with electronic meter and RCBOs. Possible connection of the district center would require a 37 km (20 kv) long transmission line. Number of population supplied: 9,000 plus Bazar

4. Conclusions

Considering the project hydrology and availability of abundant water resources, results in a PLF of more than 80%, the project's techno-commercially viability is very high, and should be attractive for investment. If a machine is operated under conditions other than full-load or full-flow then other significant inefficiencies must be considered. For domestic applications electricity is preferred.

This can be provided either:

- Directly to the home via a small electrical distribution system or,
- Can be supplied by means of batteries which are returned periodically to the power house for recharging - this system is common where the cost of direct electrification is prohibitive due to scattered housing (and hence an expensive distribution system),

5. Recommendations

Normally, small-scale hydro installations in rural areas can offer considerable financial benefits to the communities served, particularly where careful planning identifies income-generating uses for the power.

The major cost of a scheme is for site preparation and the capital cost of equipment. In general, unit cost decreases with a larger plant and with high heads of water. It could be argued that small-scale hydro technology does not bring with it the advantages of 'economy of scale', but many costs normally associated with larger hydro schemes have been 'designed out' or 'planned out' of micro hydro systems to bring the unit cost in line with bigger schemes.

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Annexure-2

Attendance Sheets of each Training Session

(To be provided by GIZ)