Project design document form
(Version 10.1)

BASIC INFORMATION	
Title of the project activity	Community-Based Renewable Energy Development in the Northern Areas and Chitral (NAC), Pakistan
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	Version 12
Completion date of the PDD	17/12/2019
Project participants	**Pakistan**: Aga Khan Rural Support Programme (AKRSP) **Germany**: Statkraft Markets GmbH **Sweden**: Swedish Energy Agency **Belgium**: Electrabel SA **Italy**: Enel Global Trading S.p.A.
Host Party	Government of Pakistan
Applied methodologies and standardized baselines	Type I – Renewable Energy Projects Category I.A. –Electricity Generation by the User, Version 12
Sectoral scopes linked to the applied methodologies	1: Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	77,478 tonnes of CO2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The Community-based Renewable Energy Development in the NAC project will invest in micro and mini hydropower projects (MHP) to serve remote rural communities in the federally administered Northern Areas and Chitral District of NWFP, Pakistan. The project aims to generate electricity from 90 projects ranging in size from 30 kW to 800 kW not exceeding 15 MW of combined installed capacity. These projects will supply mini-grids which will be isolated from any regional and national grids existing in the region. The projects will provide much needed power for meeting community energy needs at the same time substituting for the use of diesel fuel, thereby contributing to reduction of greenhouse gas emissions. The majority of those that will be served by the MHP, do not currently have access to electricity from any source. However, there is a growing trend in the consumption of diesel fuel, which is state subsidized, for power generation at the household level in rural areas replicating what is done in town centres in the NAC. Without a clean energy alternative, there would be a penetration by diesel generators into the proposed project area. NAC is facing an acute shortage of energy.

The region has rare alpine forest resources which are being consumed at unsustainable rates for domestic use, mainly cooking and heating. To a limited extent, the electricity generated by the project will provide cooking and heating energy at the household level. Although firewood use is not in the baseline for this project, its partial replacement for heating and cooking will have direct and positive impacts from reduced deforestation and will be an additional benefit of the project. Without the proposed project, use of fossil fuels and unsustainably harvested fuel wood would continue to increase despite potential for generating adequate renewable and clean energy from local streams.

NAC offers tremendous potential to generate renewable energy primarily from hydropower. NAC serves as vital upper catchments for the River Indus, on which much of Pakistan's irrigation and hydroelectricity depends. The perennial flow of water from snow melt in fast flowing streams, gives the area substantial potential to produce hydroelectricity through small, off-grid projects to serve the local area.

Plants constructed under the project will be managed and operated by a community-based management system—backed by the Engineering Section of Aga Khan Rural Support Program (AKRSP), and subsidiary engineering firms established by AKRSP in Gilgit-Baltistanand Chitral for technical support.

The project will consist of the following components:

- Setting up of power units: A total of 90 run-of-the-river hydroelectricity plants will be installed by 2012 with a combined electrical generation capacity not exceeding 15 MW.

- Establishing ownership and management systems: The project will use and expand existing community-based institutional mechanisms and capacities developed by AKRSP, including community-owned private-company-based management systems for constructing the power projects, carrying out operation and maintenance of the power units, and sale of power produced after completion of the project.

Contribution to Sustainable Development

Mini-grids powered by micro and mini-hydropower projects (MHPs) can provide a large number of rural households in mountainous areas with electricity for both domestic and productive applications and provide motive power for milling, small enterprises, and other needs. Such renewable energy systems have direct local environmental benefits in terms of:

- Substituting for existing diesel-based power generation, reducing the consumption of diesel in the region. This will result in reduced local air pollution from sulphur dioxide and particulate emissions that would otherwise result from burning of diesel. There will also be reduced need to transport fossil fuels to these remote areas.

- Reduced GHG emissions as a result of avoided burning of fossil fuels and reduced use of unsustainably harvested fire wood.
- Reduction in the use of fuel-wood and kerosene for household cooking, heating and lighting, resulting in less indoor smoke pollution especially for women and children and reduced danger of in- house fires.
- Reduction in deforestation and degradation of natural habitats of rare plant and animal species presently threatened by excessive cutting of wood and shrubs for cooking and heating in winters.

In addition to the environmental benefits the project will create opportunities for economic development and alleviation of poverty in the underdeveloped and remote mountain communities of northern Pakistan through value added to agriculture and forestry products and value added to the local gems industry and tourism services. Provisions of basic amenities such as good quality power supply, television, and possibility of mobile phone networks as a result of electrification will contribute to improved quality of life. Improved health and education services are likely to be available to local people as these remote areas become more attractive for teachers and health workers to live in.

A.2. Location of project activity

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The proposed project location is the remote mountain valleys of the Northern Areas and Chitral in proximity to Pakistan's northern borders with Afghanistan, the People's Republic of China, and Indian-controlled Kashmir. The area is rugged and mountainous, located at the confluence of four of the world's highest mountain ranges: the Himalayas, the Karakoram, the Pamirs, and the Hindukush. The region's ecology is characterized by a fragile, high mountain environment and extreme climatic conditions. The region supports over a million people, mostly living in extreme poverty in approximately 850 villages.

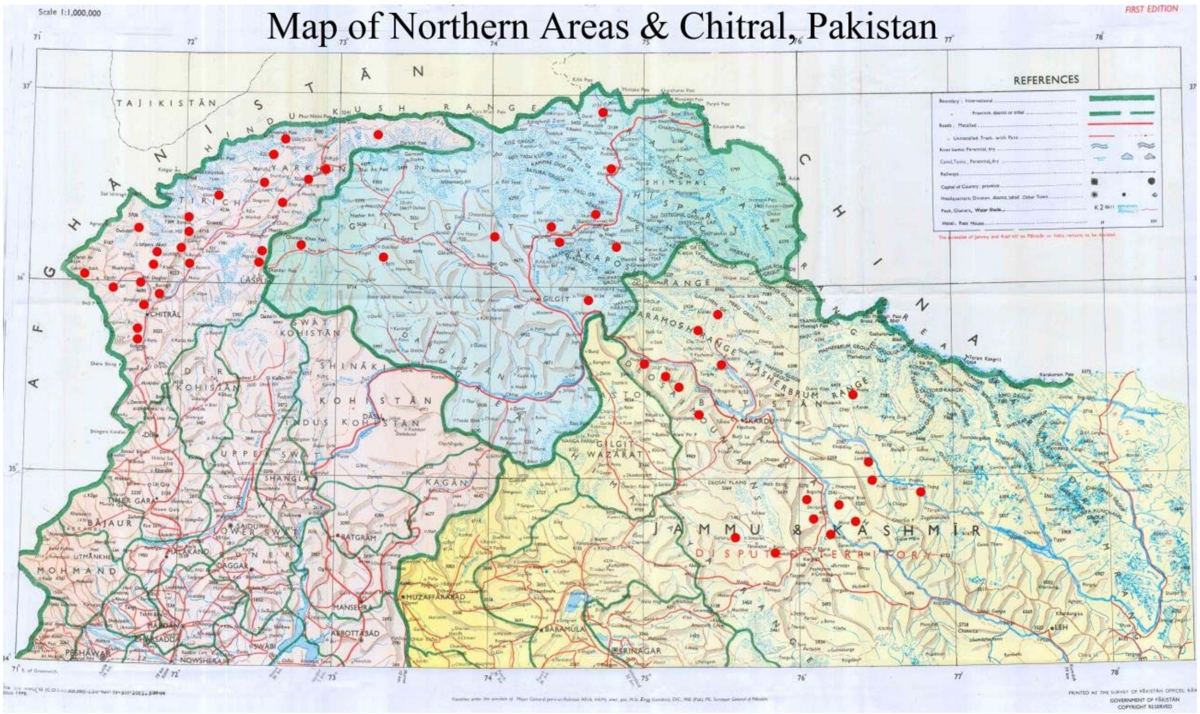

Figure 1 Map of project locations in the Northern Areas and Chitral Pakistan

A.3. Technologies/measures

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Technology to be employed by the Project Activity

A short description of micro and mini hydropower technology is provided below:

Micro and mini hydropower technology

Micro and mini hydropower units offer a proven and reliable source of electricity in locations where the hydrological resources are available and the topography is favourable for their development. The turbine converts the energy of falling water to mechanical energy which can be used directly or be converted to electrical energy, through an alternator, for use in lighting, refrigeration, milling or a number of other productive uses. As shown in the diagram below, the basic components of a hydropower unit include:

- a weir to divert water into an intake where the water enters the system,
- a channel that conveys water from the intake to the forebay tank
- a penstock pipe to transport the water from forebay tank to the powerhouse,
- a turbine located in the powerhouse to convert the energy of the falling water into mechanical rotational energy,
- a generator located in the powerhouse that converts rotational energy to electricity and a governor or electronic load controller to keep the frequency and system voltage at constant levels in response to change in load demand,
- a tailrace channel through which the water leaves the powerhouse and returns to the stream, and
- power lines to transfer power to load centres and distribute power to households.

Each country has its definitions of categories of hydropower project plant sizes. In Pakistan, ‘micro’ hydropower refers to units of less than 150 kW installed capacity, ‘mini’ hydropower refers to projects in the range of 150 kW to 5 MW, and ‘small’ hydropower between 5 MW to 50 MW1. The hydropower projects included in the proposed CDM project activity will be limited to the micro and mini hydropower ranges.

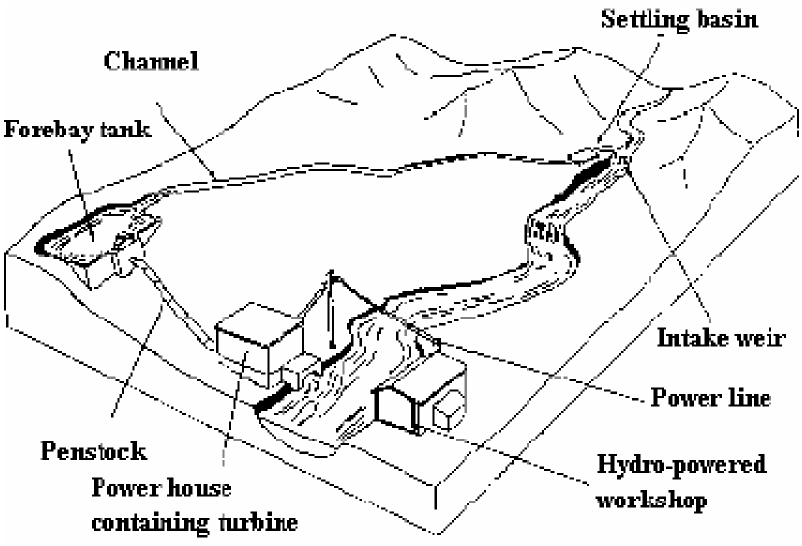


Figure 2 Simple sketch of micro-hydro[1]

Both locally manufactured and imported technology will be used for the implementation of the mini hydropower units, depending on operational specifications and requirements. The turbines that will be installed would likely fall in the categories of (a) Cross-flow, (b) Pelton wheel, (c) Francis, and possibly (d) Kaplan types. Pelton turbines are used for high head applications. Francis and cross-flow turbines cover medium head sites. Kaplan turbines are used for exceptional low head sites in less steep locations. AKRSP has previously employed only the former two in the region, as the latter two were not manufactured in Pakistan. Most sites will likely continue to utilize Cross-flow and Pelton turbines because of their robustness and ease of local fabrication. The project will introduce higher efficiency designs of the cross-flow turbine for local manufacture in cooperation with PCRET and German Technical Cooperation-GIZ. Imported technology from China and Europe may be used for the larger plants.

AKRSP will provide technical support to communities to ensure that high quality micro and mini-hydel projects are constructed and well managed and operated. On the technology, this will include efficient project designs, ensuring that the best available MHP technology on the market will be used for the installations, and introducing new technologies such as electronic load controllers to allow power plants to operate 24 hours a day. AKRSP will support communities in both design of projects and construction supervision. The project also makes provisions for meeting training and maintenance needs of the MHP projects.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of Pakistan (Host)	Aga Khan Rural Support Programme (AKRSP)	No
Germany	Statkraft Markets GmbH	No
Sweden	Swedish Energy Agency	No

[1] Source: http://en.howtopedia.org/wiki/How_to_Plan_a_Micro_Hydro-power_Plant

Belgium	Electrabel SA	No
Italy	Enel Global Trading S.p.A	No

Each community that installs a MHP will participate in the project. AKRSP will act on behalf of the 90 participating communities as a project participant. AKRSP will acquire contractual agreement from all participating communities for transfer of CER ownership and other rights to AKRSP.

AKRSP, the project proponent, is a well known non-governmental organization based in Pakistan. It is the implementer of the renewable energy project as well as the facilitator for community participation. AKRSP has, since 1991, completed more than 200 micro- and mini-hydropower schemes in six districts of northern Pakistan. To date, a total of about 10 MW of installed micro- and mini-hydel capacity has been implemented by AKRSP in the region. These projects have been executed and maintained by the local community-based Village Organizations (VOs), while AKRSP has provided technical and financial support and trained plant operators from within the communities. The plants are operating successfully. AKRSP won the prestigious Ashden Award (Green Oscars) in 2004 and the Japanese Award for Most Innovative Development Project 2005 for its community-based renewable energy programme in the area. AKRSP's main activities in the Northern Areas and Chitral include institutional development, i.e., creating village and higher level community organizations; resource development, i.e., development of small infrastructure projects, such as roads, bridges, hydel plants, irrigation channels, flood protection devices, reservoirs and water supply schemes; and market development, linking local production to local and larger markets through provision of micro-credit, as well as provision of business development services. AKRSP also works with the local government system and local communities to sustainably manage natural resources, conserve the environment and promote social forestry. Other activities include increasing productivity in food, vegetable seed, fodder and fruit crops; agricultural diversification; agro-processing and other post-harvest processing; and livestock and poultry development. The organization also carries out social, gender, and civil society development projects, community-based training and workshops, and links local organizations with available public and private sector services.

The **CDCF** is a trust fund maintained and operated by the World Bank (IBRD) in its capacity as trustee of the CDCF on behalf of its public and private participants. IBRD will be purchasing the carbon credits from the project activity through the CDCF. The Official contact for the CDM project activity is: The Community Development Carbon Fund (CDCF) of The World Bank.

The contact information of the project participants above is given in Annex 1 of this document.

The project will receive investment and technical support from the following organizations which are not project participants:

1. **Pakistan Poverty Alleviation Fund (PPAF)** is an autonomous fund set up by the Government of Pakistan to invest in community-based infrastructure projects and micro-credit for the poor and for enterprises that reduce poverty (see http://www.ppaf.org.pk/). It represents an innovative model of public private partnership and works with a total of 72 intermediary Partner Organizations (POs), one of which is AKRSP, for effective outreach to tens of thousands of Community Organizations (COs). Incorporated under section 42 of the Companies Act 1984, it follows the regulatory requirements of the Securities and Exchange Commission of Pakistan. Sponsored by the Government of Pakistan and funded by the World Bank and other leading donors the PPAF had on April 30, 2006 a resource base of US$ 633.17 million (Rs. 37,990.2 million). The target beneficiaries of PPAF are poor rural and urban communities, with specific emphasis being

placed on gender and empowerment of women. Benefits accrue directly to the vulnerable through income generation, improved physical and social infrastructure, micro-credit and training and skill development support.

2. As the lead Apex institution of the country wholesaling funds to civil society organizations, the PPAF forms partnerships on the basis of rigorous criteria. Before finalizing partnerships the PPAF ensures that the partners have well targeted community outreach programs that are committed to enhancing the social and economic wellbeing and income of the disadvantaged peoples.

The Water Management Centre (WMC) of the PPAF provide support in the form of grants to communities for approved physical infrastructure interventions and with POs providing social mobilization and technical support. WMC/PPAF is providing resources for the construction of the 90 MHPs. Identification of the projects is demand driven, and is determined by the communities through an internal participatory process.

For purposes of ownership it is mandatory for the communities to share in the cost of the project, and also to manage and maintain the infrastructure provided, and ensure equitable benefits to all community members.

Pakistan Council for Renewable Energy Technologies (PCRET) was established under the Ministry of Science and Technology by merging the National Institute of Silicon Technology (NIST) and the Pakistan Council of Appropriate Technology (PCAT). PCRET has been assigned the responsibility for research and development, dissemination, training, and promotion of renewable energy technologies. http://www.pcret.gov.pk/. PCRET areas of focus include: micro-hydel, photovoltaics, solar thermal appliances (solar cookers, solar dyers, solar water heater, solar desalination plants), wind, bio-energy (biogas, bio-oil and other bio fuels), geothermal, and energy from ocean waves. The Council has offices in Islamabad as well as the four provincial capitals of the country. PCRET will be providing electromechanical equipment for 80 MHP installations in addition to providing training support to equipment manufacturers and operators as well as technical assistance to improve the efficiency of turbines and other equipment being used for the micro-hydel installations.

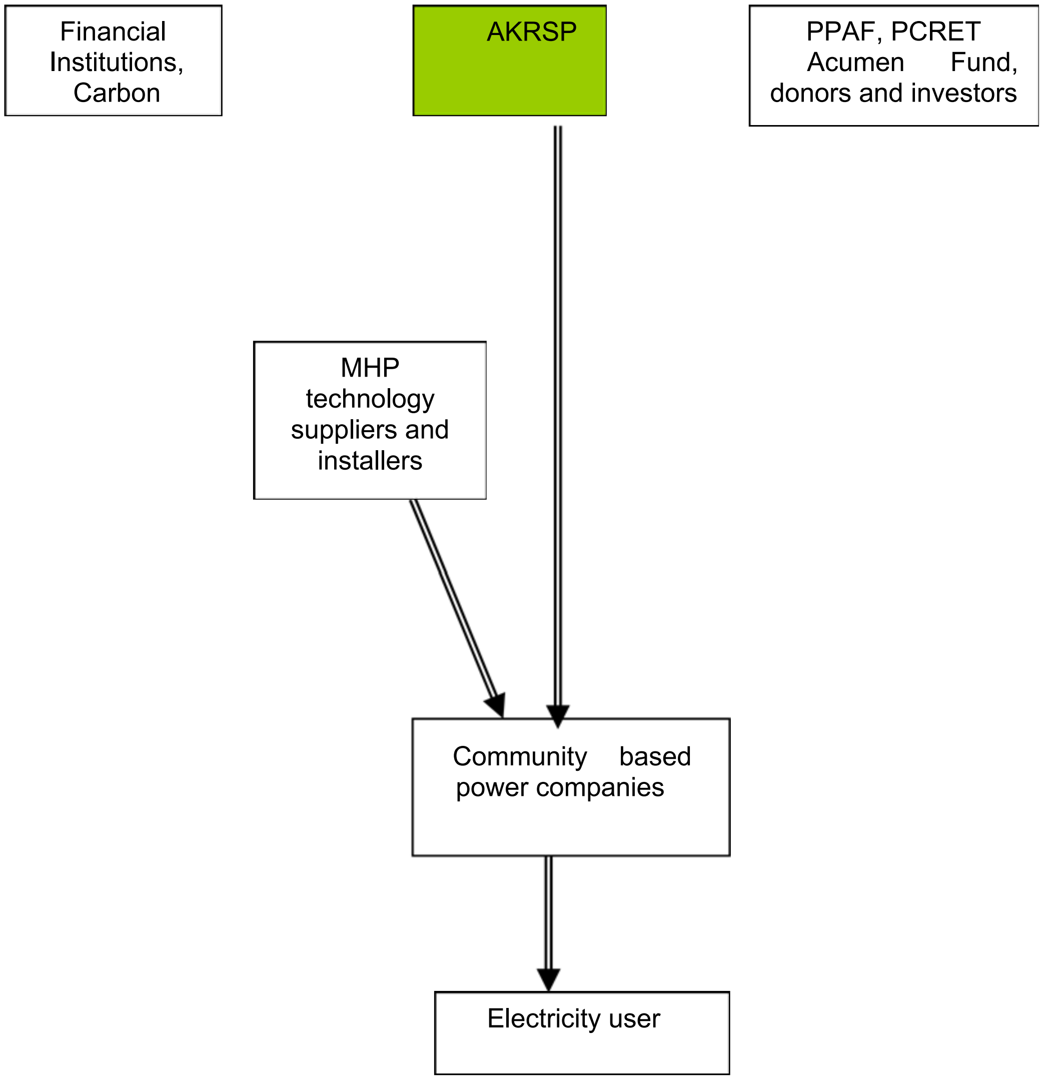
Acumen Fund

Acumen Fund is a global socially responsible investor, with offices in Pakistan - http://www.acumenfund.org/, which invests patient, flexible capital in enterprises which help the poor. It can invest in a variety of institutions, reflecting the diversity of business models that can be effective in reaching the “base of the pyramid” (BoP)without access to clean water, modern energy services, reliable health services, or formal housing options. Eligible institutions for financial support range from non-profit organizations seeking to scale their operations and achieve financial sustainability, to small and medium for- profit companies in need of capital, to larger companies that are starting specific business units to serve the BoP. Acumen can invest through a number of instruments including debt, guarantees, and equity. Acumen Fund's work in Pakistan has a strong presence in the housing sector, providing slum-dwellers with affordable legal housing and infrastructure alternatives, as well as innovative financial services that allow low income clients to improve their homes and supplement incomes. The Pakistan portfolio has grown to include investments in the health and water sectors and approved investments also include a micro insurance distribution agency and an investment in drip irrigation technologies. With the investment into “Community- Based Renewable Energy Development in the Northern Areas and Chitral (NAC)” the Acumen Fund is extending its portfolio to the alternative energy sector.

Project Implementation:

AKRSP is responsible for ensuring the overall implementation of the proposed project activity in coordination with local community based organizations and donors. The figure below illustrates the management structure of the project:

Fig. A 3.1 Structure of Management System for Project



A.5. Public funding of project activity

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The project is expected to receive public grant funding from the Pakistan Poverty Alleviation Fund (PPAF), and from the Pakistan Centre for Renewable Energy Technologies (PCRET). No public funding is expected for the project from an Annex I country and therefore there is no possibility of diversion of ODA funds.

The details of the committed amounts of public funding are given in Annex II.

A.6. History of project activity

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Not applicable.

A.7. Debundling

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The proposed project activity is not a debundled component of a large project activity. According to Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities, a proposed small-scale project activity is considered a debundled component of a large scale project activity if there is a registered small-scale CDM project activity or an application to register another small-scale project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

Since none of the above is true for the proposed CDM project activity, it is not a debundled component of a large project activity.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

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The baseline and monitoring methodologies applied for the project is based on the most recent list of the small-scale CDM project activity categories contained in Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities.

The project falls under,

Type I – Renewable Energy Projects
Category I.A. –Electricity Generation by the User Version 12

The approved baseline and monitoring methodology, given in Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities, relevant to this project are available at:
http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_VECB8EZJV6NSM13KPOVCDL O9PB R4OY

B.2. Applicability of methodologies and standardized baselines

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According to Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities, Category I. A. “Electricity Generation by the User” comprises “renewable energy generation units that supply individual households or users or groups of households or users with electricity. The applicability is limited to households and users that do not have a grid connection except when a group of households or users are supplied electricity through an isolated mini-grid where the capacity of the generating units shall not exceed 15 MW. These units include technologies such as solar power, hydropower, wind power, and other technologies……”

The proposed project activity involves hydropower projects which will supply isolated mini-grid distribution systems. In the absence of the project, the consumers that will be supplied electricity on these mini-grids would have eventually been supplied by diesel generators at the household level or through mini-grids. As such this project qualifies under Category I-A of Appendix B of the small-scale guidelines.

B.3. Project boundary, sources and greenhouse gases (GHGs)

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According to the baseline methodology for project category I.A.,"The physical, geographical site of the renewable energy generating unit and the equipment that uses the electricity produced delineates the project boundary."The geographic project boundary selected for the project activity is the political boundary that covers the remote, mountainous federally administered Northern Areas and Chitral (NAC) region of Pakistan. Micro- and mini-hydropower projects will be constructed in those rural areas of the NAC where there is no access to the national or regional grid or supply through isolated generation by the Public Works Department in the Northern Areas or the Sarhad Hydel Development Organization (SHYDO) in Chitral. This lack of access to the National Grid means that data for the rest of the country cannot be applied to the NAC

situation. Power will be distributed through mini-grids in the vicinity of the hydropower plants and will be used to meet domestic electricity needs and power for productive end-uses.

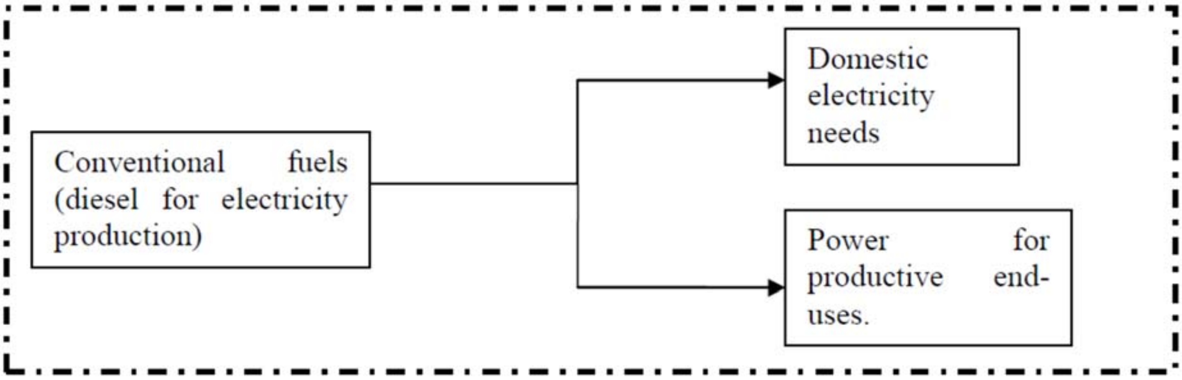

Figure 3 Baseline emissions project boundary

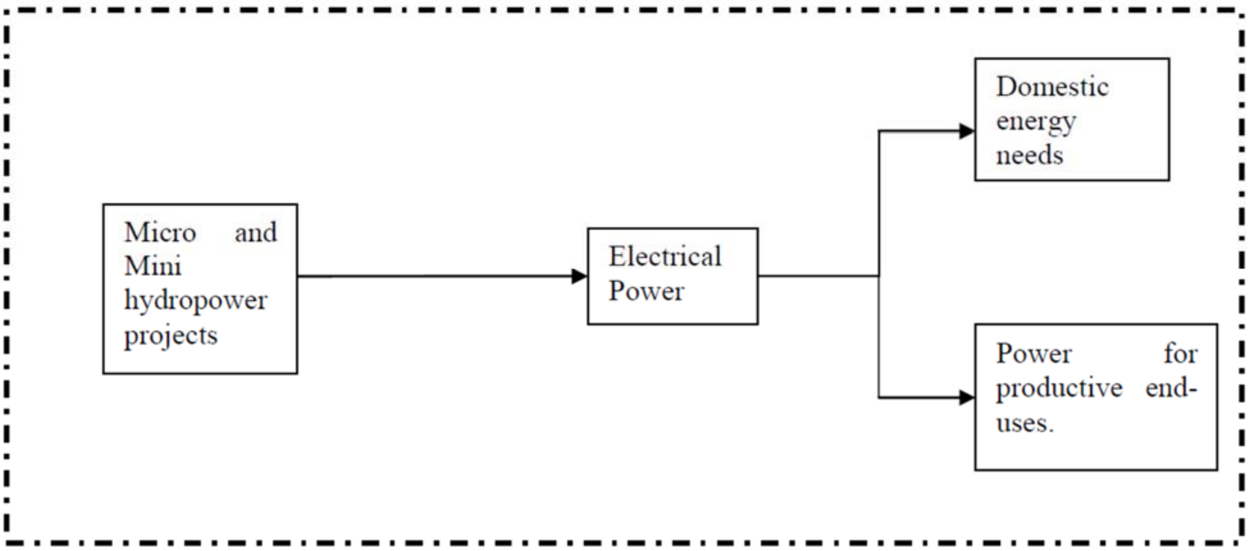

Figure 4 Project boundary

B.4. Establishment and description of baseline scenario

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The baseline for Category I. A. Electricity generation by the user of Type I – Renewable Energy Projects is given as:

"The energy baseline is the fuel consumption of the technology in use or that would have been used in the absence of the project activity. The project participants may use one of the following energy baseline formulae:

(a) Option 1:

$$EB = \Sigma_i(n_i \cdot c_i)/(1 - l)$$

Where:

- ***EB*** annual energy baseline in kWh per year.
- ***Σi*** the sum over the group of "i" renewable energy technologies (e.g. residential, rural health centre, rural school, mills, water pump for irrigation, etc.) implemented as part of the project.
- ***ni*** number of consumers supplied by installations of the renewable energy technology belonging to the group of "i" renewable energy technologies during the year.
- ***ci*** estimate of average annual individual consumption (in kWh per year) observed in closest grid electricity systems among rural grid connected consumers belonging to the same group of "i" renewable energy technologies. If energy consumption is metered, ci is the average energy consumed by consumers belonging to the group of "i" renewable energy technologies.
- ***l*** average technical distribution losses that would have been observed in diesel powered mini-grids installed by public programmes or distribution companies in isolated areas, expressed as a fraction.

OR

(b) Option 2:

$$EB = \Sigma_i O_i /(1 - l)$$

Where:

- ***EB*** annual energy baseline in kWh per year
- ***Σi*** the sum over the group of "i" renewable energy technologies (e.g. solar home systems, solar pumps) implemented as part of the project.
- ***Oi*** the estimated annual output of the renewable energy technologies of the group of "i" renewable energy technologies installed (in kWh per year)
- ***l*** average technical distribution losses that would have been observed in diesel powered mini-grids installed by public programmes or distribution companies in isolated areas, expressed as a fraction."

Option 2 is selected to determine the baseline emissions for the proposed project activity. The emissions baseline is calculated using the aggregate of annual kWh output of all MHP power plants, divided by the (1-l) factor to take into account avoided technical distribution losses, times the CO_2 emission coefficient for the fuel displaced. As per the methodology, a reasonable default value for distribution losses on low voltage rural distribution grid could be 20%.This also reflects the standard technical transmission and distribution losses for diesel powered mini-grids installed by public sector organizations such as Sarhad Hydel Development Organization (SHYDO) in Chitral and the Public Works Department in Northern Areas serving more urban areas in the NAC.

According to the approved methodology a default value of 0.8 KgCO2e/kWh which is derived from diesel generation units, may be used as the emission factor. However, a small-scale project proponent may, with adequate justification use a higher emissions factor from Table I.D.1 under category I.D.The emission factor of 1.24 kg CO2eq/kWh has been used based on Table I.D.1, reproduced below in Table B.4.1,of the Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories I.D/ Version 12. The diesel generators which would be replaced by the micro-hydel projects to be installed have characteristics most similar to the 50% load factor category in the Table B.4.1, for option *Mini-grid with temporary service (4-6 hr/day).*

Table B.4.1

Table I.D.1: Emission factors for diesel generator systems (in kg CO2equ/kWh*) for three different levels of load factor**

Cases	Mini-grid with 24-hour service	i) Mini-grid with temporary service (4-6 hr/day) ii) Productive applications iii) Water pumps	Mini-grid with storage
Load Factor (%)	**25%**	**50%**	**100%**
< 15 kW	2.4	1.4	1.2
>=15 <35 kW	1.9	1.3	1.1
>=35 <135 kW	1.3	1.0	1.0
>=135<200 kW	0.9	0.8	0.8
> 200 kW***	0.8	0.8	0.8

** A conversion factor of 3.2 kg CO2 per kg of diesel has been used (following revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories)*
*** Figures are derived from fuel curves in the online manual of RETScreen International's PV 2000 model, downloadable from http://retscreen.net/*
**** default values*

The factor 1.24 kg CO2eq/kWh has been computed from a weighted average in the size ranges: <15 kW, >=15 <35 kW, >= 35<135 kW, >=135<200 kW, and >200 kW - among the sample of generators surveyed in the NAC region in May/June 2007.

Table B.4.2 Emission Factor based on Table I.D.1

Capacity	Sample	Weight	EF as per I.D	Wtd EF
< 15 KW	23	0.46	1.4	0.644
> = 15 < 35 KW	13	0.26	1.3	0.338
> = 35 < 135 KW	9	0.18	1	0.18
> = 135 < 200 KW	2	0.04	0.8	0.032
> = 200 KW	3	0.06	0.8	0.048
	50		**Total Wtd EF**	**1.24**

The 2007 survey carried out of diesel generators operating in the NAC region, see Table B.4.3, found that actual emission factors are much higher than the values shown in Table I.D.1 under the 50% load factor column. The survey, which was carried out in all three regions covered by the project – Gilgit, Chitral, and Baltistan, showed that diesel gensets, particularly in the commonly found smaller sizes, being used in this region generally have emission coefficients which are significantly higher than that specified by the manufacturers. The likely explanation for this finding is that the gensets being used are not being maintained well and many are of inferior brands. The larger gensets operated by the Public Works Department have much lower emission coefficients since they use high quality equipment which they maintain regularly.

Table B 4.3shows that emission factors in the survey varied by generator size and comes to an average of 2.25 kg CO2eq /kWh for small generators, in the <15 kW size category - which is the size category of generators that is most likely to be displaced by the micro-hydropower plants being installed under the project. Details of the survey and its results are given in Annex 3.

Table B 4.3 Emission Coefficients of different size generators based on survey results

Category	Number of generators surveyed	Measured fuel efficiency (kWh/litre)	Litres of diesel/ kWh	kg of diesel/kWh	kg CO_2eq/ kWh
< 15 kW	23	1.19	0.84	0.70	2.25
>=15 <35 kW	13	1.47	0.68	0.57	1.82
>=35 <135 kW	9	1.73	0.58	0.48	1.55
>=135 <200 kW	2	2.78	0.36	0.30	0.96
>= 200 kW	3	3.03	0.33	0.28	0.89

The survey found that the more rural areas of the three regions, where the micro/mini-hydropower projects are slated to be installed, were served by smaller size generators mostly in the < 15 kW category. The larger size gensets in the >=35 <135kW, >=135 < 200kW, and >200 kW are mostly in urban centres with installations in the last two categories being operated exclusively by the government Public Works Department and SHYDO. The emission factor of 1.24 kg CO2eq/kWh is conservative by taking the weighted average by size categories of surveyed generators whereas the generators to be displaced by the project are almost all in the < 15 kW. Secondly Table 4.3 shows that actual emission factors of diesel generators working in the field are higher than what is listed in Table I.D.1.

Leakage

All 90 projects will use newly manufactured turbines, governors, and penstock pipes. No electricity generating micro-hydel equipment which has been used elsewhere will be transferred into the project boundary. While it is not expected that there will be a significant transfer of existing diesel gensets to other areas after the communities are supplied by micro and mini-hydropower systems, old gensets will be scrapped by the communities after the advent of hydropower, as per the Terms of Partnership (TOP) with AKRSP. New gensets will continue to be used in the communities as backup power in case of breakdown of the MHP. Should any gensets be sold outside the project boundary, in violation of the TOP, the leakage emissions will be monitored by AKRSP and records kept for verification by the DOE.

B.5. Demonstration of additionality

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The electricity supply in northern Pakistan does not at present supply even half of the local population. Although their penetration into rural areas is still very limited, off-grid diesel-run generators are increasingly being installed in un-electrified areas as their capital costs are low and they are readily available. With strong demand for electricity in un-electrified areas, there is high likelihood of significant additional diesel- generation being installed in the area, including in areas where the MHP installations are likely to be carried out. This will result in additional fossil fuel consumption and increased GHG emissions, besides being a costly source of electricity due to high petroleum prices, transportation and storage expenses.

The proposed project will reduce greenhouse gas emissions that would otherwise be produced from the use of diesel-based generators. Diesel generators are the most ready means of meeting the needs of un-electrified populations, which are not connected to the national electricity grid due to the

remoteness of the communities and mountainous terrain. The GHG emissions mitigated would include carbon dioxide and oxides of nitrogen.

This project is additional and would not have occurred anyway because of a number of barriers that prevent investments in micro- and mini-hydropower investments in the NAC region of Pakistan. With reference to Attachment A to Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities, the proposed project activity faces specific barriers related to investment and technology as described below.

Investment Barrier

AKRSP aims to construct micro and mini hydropower projects (as given in Table B 5.1) of cumulative capacity not exceeding 15 MW in cooperation with 90 beneficiary communities in the NAC area of Pakistan.

The implementation of the proposed activity requires a considerable amount of upfront capital. In order to install 15 MW of cumulative power, the MHP program will require total funds of PKRs 1,070.56 million (~ US $17.842 million). This includes capital expenditures required for procurement of equipment and construction, the costs of management of the program, supervision during construction and local labour and materials. The required funds for implementing the program will come from a number of supporting organizations (PPAF, PCRET), private investors like the Acumen Fund, as well as the local beneficiary communities which will be expected to contribute around 18% of the total project cost in the form of labour and in-kind contribution. Community contribution is capitalised as the equity of each participating household into the community-owned project.

AKRSP has executed more than 200 micro-hydel projects in the 5 kW to 200 kW range mainly in the Chitral region since its inception in 1983. Most of these projects were constructed during 1980's and 1990's with international grant funding. There is however currently very limited grant funding available from international donors for AKRSP's micro-hydel programme or other infrastructure projects. The decline in availability of funding is due to a change in donor focus towards tribal areas bordering with Afghanistan as a result of recent international political developments. The number of micro hydropower projects initiated by AKRSP by year is shown in Fig B 5.1. While there was substantial international funding for new projects in the ten year period (1992-2003), allowing as many as 33 projects to be started in 1999; this had shrunk significantly to one new project each in 2004 and 2005. In this remote and impoverished mountain region poor economic conditions combined with recent political risk due to security instability in this border region, the area does not meet typical credit criteria for commercial lending. It is simply too poor and too risky for commercial lending.[2][3][4][5]

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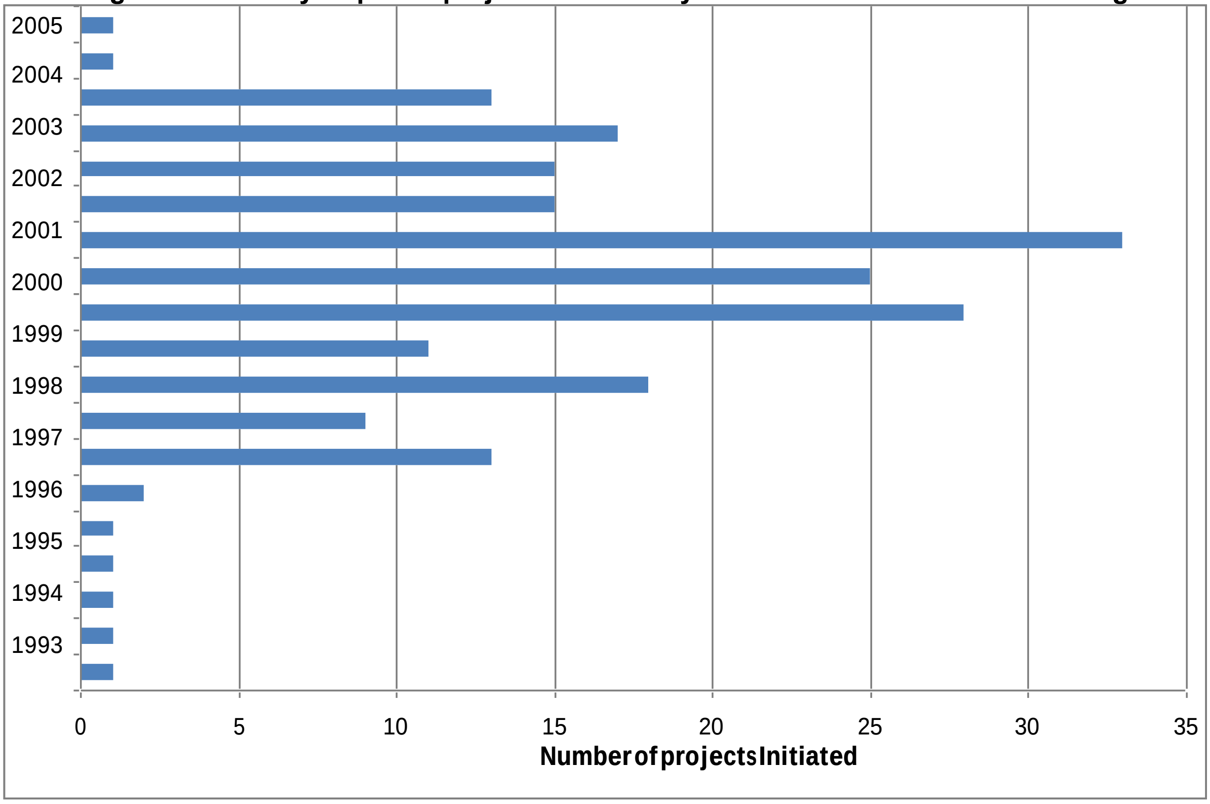
[2] World Bank Country Assistance Strategy for Pakistan (http://go.worldbank.org/LZP7LI9EG0)

[3] World Bank Publication: Getting finance in South Asia 2009

[4] Doing Business, Pakistan 2009 (http://go.worldbank.org/MCT64JUBC0)

[5] Bringing Finance to the Poor (http://go.worldbank.org/0KKMYAT130)

Fig B 5.1 Micro hydropower projects initiated by AKRSP with international funding



This decline in international funding encouraged AKRSP in 2005 to contact the Community Development Carbon Fund (CDCF) of the World Bank to seek carbon financing for developing the next group of MHPs in Northern Areas and Chitral under community management. National partners, Pakistan Poverty Alleviation Fund (PPAF) and Pakistan Council for Renewable Energy Technologies (PCRET), have agreed to provide grants to AKRSP to partially cover costs for equipment and construction of the micro-hydel plants in Northern Areas and Chitral with the understanding that the project will access carbon financing to achieve financial closure. In addition to these grants, private equity investment from the Acumen Fund is expected into the project of approximately 12% of the project cost. This has been made possible because Acumen Fund expects a share of the carbon revenue to generate an investment return for it and to cover the cash flow requirements of the project. AKRSP has to rely on commercial debt for the remaining 18% of the total investment to cover the financing gap. The commercial debt was also expected from the Acumen Fund, but due to recent changes in its portfolio investment criteria for the region, it can only consider financing up to a maximum of US$ 2m in a first round of financing, with more funding potentially possible in subsequent rounds of financing, depending on performance of the project. This leave an existing financing gap, as of August 22nd, 2009, which AKRSP hopes to close by raising future financing based on expected future carbon revenues to be generated. If the project ends up being eligible for subsequent rounds of financing from Acumen, combined financing from the Acumen Fund could constitute as much as 30% of total project cost. However, it is too early to tell as any funding by Acumen is still under consideration and is not committed yet. The carbon revenue generated by the project will be used to provide returns to the private investors and to repay this loan, whomever it may come from. Socially responsible venture capital investor Acumen Fund is carrying out final due diligence for providing both equity and debt financing to the project to cover this gap and has concluded that investment into the project provides a viable opportunity provided carbon revenues can be generated as projected (see letter Nov 3rd, 2008). As further communication from the Acumen Fund demonstrates, financial closure has not yet been achieved. The financing gap in the project cannot be closed without the expected carbon revenue.

Table B 5.1 provides the list of the projects to be constructed, their sizes, location, the year when they would be commissioned, and expected project costs. The engineering design has been carried out based on field surveys for each of the 90 project sites. The project summary reports show that cumulative power output of 90 projects is within the 15 MW threshold. The projects to be completed in 2008 have accurate costs based on detailed design. Construction costs are estimated for projects to be completed in subsequent years based on the experience of the first eight projects and previous experience of AKRSP in the construction of micro- hydropower projects to be $1,062 per kW. This includes equipment purchases, cost of construction materials and skilled labour, and the community in-kind contribution. The total project construction cost comes to US$ 15,930,999. A construction supervision cost of 12%, to be charged for AKRSP design and supervision services, is added to this cost to arrive at a total project cost of $17,842,719 resulting in a final installation cost of $1,189 per kW.

Table B 5.1: Hydropower Projects to be Constructed under the CDM Project Activity

S. No.	Commissioned Year*	Name of Project	Region	District	Tehsil	Size[6] (MW)	Project Cost (US$)
1	2008	Besil	Baltistan	Skardu	Shigar	0.200	136,667
2	2008	Memushthang	Baltistan	Skardu	Kharmang	0.050	36,333
3	2008	Brep	Chitral	Chitral	Mastuj	0.200	282,000
4	2008	Onawich	Chitral	Chitral	Mastuj	0.050	48,333
5	2008	Bilphok	Chitral	Chitral	Chitral	0.050	40,833
6	2008	Terich Bala	Chitral	Chitral	Mastuj	0.080	86,667
7	2008	Kishmanja	Chitral	Chitral	Mastuj	0.050	54,167
8	2008	Baleem Laspur	Chitral	Chitral	Mastuj	0.080	86,667
9	2008	Overik	Chitral	Chitral	Chitral	0.050	54,167
	2008	**Sub-total**				**0.810**	**825,833**
10	2009	Chatpa Katisho	Baltistan	Skardu	Skardu	0.100	62,500
11	2009	Ahmedabad	Gilgit	Gilgit	Hunza	0.350[7]	211,833
12	2009	Hushay	Baltistan	Ghanche	Mashabroom	0.160	173,333
13	2009	Izh	Chitral	Chitral	Chitral	0.108	117,000
14	2009	Dapa	Baltistan	Skardu	Kharmang	0.160	173,333
15	2009	Katisho	Baltistan	Skardu	Kharmang	0.100	108,333
16	2009	Memush	Baltistan	Skardu	Kharmang	0.030	32,500
17	2009	Bireer	Chitral	Chitral	Chitral	0.080	86,667
18	2009	Chowar	Baltistan	Ghanche	Khaplu	0.160	173,333
19	2009	ShahSalim	Chitral	Chitral	Chitral	0.050	54,167
	2009	**Sub-total**				**1.348**	**1,193,000**
20	2010	Hango	Baltistan	Skardu	Rondu	0.100	108,333
21	2010	Shagarthang	Baltistan	Skardu	Skardu	0.100	108,333
22	2010	Gobor Merdeen	Chitral	Chitral	Chitral	0.108	117,000
23	2010	Doko	Baltistan	Skardu	Shigar	0.160	162,500
24	2010	Haltanmosa Hagosil	Baltistan	Skardu	Kharmang	0.120	130,000
25	2010	Zhitur	Chitral	Chitral	Chitral	0.108	117,000
26	2010	Shagram	Chitral	Chitral	Chitral	0.168	182,000
27	2010	Beshgram	Chitral	Chitral	Chitral	0.200	216,667

[6] The power plant size is based on generator capacities (in MW) as per the General Guidelines to SSC CDM methodologies, Version 17

[7] The capacity of MHP Ahmedabad is 350 kW instead of 400 kW from 09/09/2015. The reason for such situation is because the old alternator was replaced due to technical fault hence the capacity was changed to 350 kW from 400 kW, increasing the real cost at once implemented, Conservatively, the project cost has not been altered since it is an unexpected cost not considered at the determination of the project additionality.

28	2010	Diezgh	Chitral	Chitral	Mastuj	0.240	260,000
29	2010	Begust	Chitral	Chitral	Chitral	0.108	117,000
30	2010	Whaat	Chitral	Chitral	Chitral	0.108	117,000
31	2010	Wazirpoor	Baltistan	Skardu	Shigar	0.100	108,333
32	2010	Momi	Chitral	Chitral	Chitral	0.240	260,000
33	2010	Zondarngram	Chitral	Chitral	Mastuj	0.240	260,000
34	2010	Sunich	Chitral	Chitral	Chitral	0.125	135,417
	2010	**Sub-total**				**2.225**	**2,399,583**
35	2011	Ganuk	Baltistan	Skardu	Kharmang	0.150	162,500
36	2011	Arkari	Chitral	Chitral	Chitral	0.320	346,667
37	2011	Moorkhun	Gilgit	Gilgit	Hunza	0.400	433,333
38	2011	Yurjogh	Chitral	Chitral	Chitral	0.160	173,333
39	2011	Lunkha	Baltistan	Ghanche	Khaplu	0.100	108,333
40	2011	Bargo	Gilgit	Gilgit	Gilgit	0.300	325,000
41	2011	Arundu	Chitral	Chitral	Chitral	0.216	234,000
42	2011	Gartanza Shishkat	Gilgit	Gilgit	Gojal	0.400	433,333
43	2011	YalboSabsar	Baltistan	Skardu	Rondu	0.200	216,667
44	2011	HandrapKasundar	Gilgit	Ghizer	Yaseen	0.200	216,667
45	2011	Susum	Chitral	Chitral	Chitral	0.108	117,000
46	2011	Koghuzi	Chitral	Chitral	Chitral	0.160	173,333
47	2011	Kiyar	Chitral	Chitral	Chitral	0.108	117,000
	2011	**Sub-total**				**2.822**	**3,057,167**
48	2012	Mastuj	Chitral	Chitral	Mastuj	0.150	162,500
49	2012	RauGole	Chitral	Chitral	Chitral	0.175	189,583
50	2012	Bhoroghol	Chitral	Chitral	Mastuj	0.050	54,167
51	2012	Konar	Baltistan	Skardu	Gultari	0.108	117,000
52	2012	Pawoor	Chitral	Chitral	Mastuj	0.800	866,667
53	2012	Kujokshal	Gilgit	Gilgit	Nagar	0.240	260,000
54	2012	Shamshal	Gilgit	Ghizer	Hunza	0.125	135,417
55	2012	Shogore	Chitral	Chitral	Mastuj	0.500	541,667
56	2012	Mir Malik	Gilgit	Astore	Astore	0.108	117,000
57	2012	Gasht	Chitral	Chitral	Mastuj	0.200	216,667
58	2012	Madaklashd	Chitral	Chitral	Chitral	0.250	270,833
59	2012	Parabeg	Chitral	Chitral	Chitral	0.250	270,833
60	2012	Parsan Munoor	Chitral	Chitral	Chitral	0.108	117,000
61	2012	Barkulti Par	Gilgit	Ghizer	Yaseeni	0.075	81,250
62	2012	Gazeen	Chitral	Chitral	Mastuj	0.150	162,500
63	2012	Droshp	Chitral	Chitral	Chitral	0.500	541,667
64	2012	Shonoghor Chitisar	Chitral	Chitral	Mastuj	0.075	81,250
65	2012	Rosh Gole	Chitral	Chitral	Mastuj	0.125	135,417
66	2012	Sarghoz Yarkhunlasht	Chitral	Chitral	Mastuj	0.075	81,250
67	2012	Ursoon	Chitral	Chitral	Chitral	0.050	54,167
68	2012	Bulachi	Gilgit	Astore	Astore	0.065	81,250
69	2012	KuzhBala	Chitral	Chitral	Mastuj	0.108	117,000
70	2012	KhotBala	Chitral	Chitral	Mastuj	0.125	135,417
71	2012	Hinjeel Gobobakh	Chitral	Chitral	Chitral	0.125	135,417
72	2012	RechBala	Chitral	Chitral	Mastuj	0.250	270,833
73	2012	Birzeen	Chitral	Chitral	Chitral	0.250	270,833
74	2012	Bamborait	Chitral	Chitral	Chitral	0.220	238,333
75	2012	Rabat Arkar	Chitral	Chitral	Chitral	0.075	81,250
76	2012	Rowa	Chitral	Chitral	Chitral	0.108	117,000
77	2012	Miragaram Yarkhoon	Chitral	Chitral	Mastuj	0.200	216,667
78	2012	Oveer Arkari	Chitral	Chitral	Mastuj	0.125	135,417
79	2012	Golain Istore	Chitral	Chitral	Chitral	0.108	117,000

80	2012	Raman Harcheen	Chitral	Chitral	Chitral	0.500	541,667
81	2012	Chuinj Melp	Chitral	Chitral	Mastuj	0.108	117,000
82	2012	Langole Ujnu	Chitral	Chitral	Mastuj	0.250	270,833
83	2012	Rumboor	Chitral	Chitral	Chitral	0.250	270,833
84	2012	Ghoru	Chitral	Chitral	Mastuj	0.125	135,417
85	2012	Besti Shenjure	Chitral	Chitral	Chitral	0.150	162,500
86	2012	Chapali	Chitral	Chitral	Mastuj	0.150	162,500
87	2012	Zhupoo Melp	Chitral	Chitral	Mastuj	0.108	117,000
88	2012	Bang Ashrate	Chitral	Chitral	Mastuj	0.108	117,000
89	2012	Sore Laspur	Chitral	Chitral	Mastuj	0.125	135,417
90	2012	Phasti	Chitral	Chitral	Chitral	0.048	52,000
	2012	**Sub - Total**				**7.795**	**8,455,417**
		Grand Total				**14.950**	**15,930,999**

**Commissioning is construction completion of physical works of the project.*

Table B 5.2 shows a breakdown of the financing required to carry out the entire CDM project activity. The PPAF grant for the program will cover 33% of the total cost (US$ 6.000 million). Support from public sources like the Pakistan Centre for Renewable Energy Technologies (PCRET) will cover about 19% of the cost ($3.333 million).Private sector investors, such as Acumen Fund,are expected to invest as much as12% of the total cost ($2.053 million). Acumen Fund is considering an initial investment of US$2million in the first round of financing, with possibility for follow-on financing depending on performance and flow of carbon revenue. Further equity and loans are still being sought. Private investors expect to earn returns on investment from income generated from expected carbon revenue. There will need to be a loan component on commercial terms to cover the funding gap of 18% of total cost ($ 3.270 million) as grant funding is not in place for the full program. The loan will be repaid from carbon revenues from the CDM project. It is expected that around US$ 8 million in carbon revenue will be generated by the project during the first crediting period (seven years) from 29/10/2009 till 28/10/2016. In addition to repaying the loans, this revenue will be shared with the beneficiary communities and investors.

Table B 5.2 Financing for Project

Total Project Cost	$17.842 million	100%
Pakistan Poverty Alleviation Fund	$6.000 million	33%
Public sources of funding (PCRET)	$3.333 million	19%
Private Sector Equity (Acumen Fund is considering investment of US$2million; other sources being pursued)	$2.053 million	12%
Commercial Loan (still being sought; to be covered with carbon revenue and tariff)	$3.270 million	18%
Community Investment	$3.186 million	18%

On the basis of experience of implementing existing projects, the annual operation and maintenance cost (O&M) of the hydel projects is estimated as 5% of the project capital cost. The electricity tariff is assumed, for the base year 2008, to be Rs 1.25 (US cents 2.08), Rs 2.50 (4.17 cents) and Rs 4.00 (6.67 cents) per kWh for three proposed categories of consumers –lifeline domestic, higher consumption domestic, and commercial - respectively, with tariff increasing annually commensurate with an expected inflation of 5%. It is assumed that 75% of the energy will initially be sold to customers at the lifeline consumption level. Plant life is assumed to be 20 years.

The outcome of the financial analysis is summarized in Table B 5.3.

Table B 5.3: Summary Financial Analysis for Consolidated 90Projects

Power capacity installed	15 MW
Annual energy production	65.7 GWh
Total estimated cost	US$17.842 million
Average tariff revenue per year	US$1.59 million
Return on Equity (ROE) (with public sector grants) including carbon revenue	23%
ROE (with public sector grants) excluding carbon revenue	9.28%

The analysis is carried out using the following assumptions:

a) Equity investment for the project is provided as community investment plus private sector investment to make a total of $3.186 million + $2.053 million = $5.239 million. Private sector investors expect to receive commercial returns on their investment from the carbon revenue generated by the project.
b) Public sector grants are available to the project as investment from PPAF plus PCRET making a total grant of $6.000 + $3.333 = $9.333 million.
c) The project will take a commercial loan of $3.270 million to close the financing gap which it will repay by the year 2015 with carbon revenue.
d) IRR on Equity investment (Return on Equity) is calculated taking into account project expenses, loan repayment, and revenue streams from beginning of project construction in 2006 till the year 2020. Although the life of the power plants are assumed to be 20 years, it is expected that the power plants constructed in the earlier years, 2008-09, will need major repairs and replacement of equipment after 2020. It is assumed that electro-mechanical equipment will have a life of 12 years, as per common practice will locally fabricated equipment. It is likely that a substantial part of the revenue generated by the projects beyond 2020 will go to replacement of turbines, and generators. Carbon finance is included up to year 2020, and the cost of retrofit is not included in the IRR calculations as it would largely occur after that date. Analysis into the future is made uncertain by the considerable uncertainty in future carbon prices.
e) The price per ton of CO2 abated till 2014 is expected to be $16.5 and is estimated to be half this amount after 2014.7

The financial analysis shows that the internal rate of return (IRR) on Equity for the consolidated 90 projects with the committed grants and carbon revenue8 accruing till 2020 comes to 23%. This is an attractive IRR for the project investors: communities and private investors. The IRR on Equity for the project without carbon revenue is 9.28%. While this might be acceptable for a social enterprise such as the one proposed here, it is too low to attract investment from the private sector into the project. Ten year bonds issued by government or corporate entities yielding 10-12% annually are taken as a comparative rate of return. For a project to be attractive to the private sector, a minimum acceptable IRR is considered to be 15%9.

It must be pointed out here that, although important, the improvement in the IRR with carbon financing is not the critical factor demonstrating the additionality of this project activity. The primary investment barrier for this project is that the financing gap in the project would not be closed without both a commercial loan and equity investment from the private sector. These private parties would not have reason to invest in this project without the carbon finance revenue stream. They would not expect to be repaid or receive dividends if the only source of project revenue would be electricity tariff collections from project beneficiaries in remote mountain communities. The project is additional since it could not have been implemented without the expected carbon revenue.

Technology barrier

Micro and mini hydropower are well established technologies. Nevertheless at the community level, construction of a power project is a complex undertaking that requires technical and managerial skills that are not locally available in the NAC region. AKRSP has previous experience with designing over 200micro and mini hydropower projects and in organizing communities to construct and manage and operate them. In addition, implementing the technology in this remote mountainous Himalayan terrain that is tectonically active is a unique skill set which AKRSP has learned through experience and cannot be taught. It is anticipated that both local and imported technology will be needed for the implementation of the mini hydel units. AKRSP will assure that the best available MHP technology on the market will be used for the installations. AKRSP will also collaborate with PCRET and GIZ to introduce more efficient cross-flow turbine designs for local manufacture and technologies such as electronic load controllers which are proven internationally but are not yet easily available in Pakistan. Without quality control and strict inspection, there is the risk that equipment suppliers and manufacturers will provide low quality equipment. Such equipment would lead to frequent breakdowns creating low performance and extra maintenance burden on poor communities. Civil construction needs to be carried out to high standards if the projects are to operate optimally over their full economic life. AKRSP will support communities in both design and construction supervision to ensure this. Since rural communities cannot discern the quality of purchased equipment or of civil design and construction, AKRSP through the proposed project will undertake the technical design of projects and construction supervision. Communities will be advised to procure equipment only from reliable suppliers and manufacturers.

In addition to support during equipment procurement and project construction, AKRSP will also provide support for training and help set up a mechanism to make sure maintenance needs are met. For each MHP project, provisions are made for two operators to be trained during installation and commissioning of the project. The Pakistan Council for Renewable Energy Technologies (PCRET) Pakistan will support training needs of both the AKRSP project personnel as well as equipment manufacturers. As per its standard methodology, AKRSP will require the communities to establish a maintenance fund amounting to 5% of the project construction cost for sustainable maintenance of the completed projects. This fund will be required to be collected by the beneficiary communities before commissioning of each project. Whenever this fund is utilised, the maintenance committees will again collect money from community members to replenish this fund for future maintenance needs. Furthermore, the tariff collected from users will also be deposited in the maintenance account to use for operation and maintenance of the projects.
AKRSP support to the communities to access good quality technology, to maintain quality control, acquire training and to establish a maintenance fund for each project would not be possible in the absence of this CDM project activity.

In the face of the investment and technological barriers described above communities would likely use diesel based power generation if it were not for the proposed CDM project activity.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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Baseline emissions

The formulae given in Appendix B to calculate energy baseline has been used as explained in Sections B.2 and B.4 above. The calculation of GHG emissions reduction has been presented below.

$E_B = \Sigma_i O_i / (1-l)$

Where

- E_B = annual energy baseline in kWh per year
- Σ_i = the sum over the group of "i" renewable energy technologies (e.g. solar home systems, solar pumps) implemented as part of the project
- O_i = the estimated annual output of the renewable energy technologies of the group of "i" renewable energy technologies installed (in kWh per year)
- l = average technical distribution losses that would have been observed in diesel powered mini-grids installed by public programs or distribution companies in isolated areas, expressed as a fraction

The aggregation of the annual kWh meter readings of all the micro-hydro systems give the (ΣiOi); the distribution losses 'l' has been taken to be 0.2 as the technical losses on mini-grid distribution systems managed by the SHYDO and Public Works Department in urban areas of the NAC. The annual energy baseline in kWh per year (EB)comes out to be the sum of all the annual meter readings at the hydel power houses divided by 0.8, to take into account the avoided transmission losses from locally generated power.

Total annual emission reductions can be calculated by multiplying EB by the emission coefficient of the displaced fuel. An emission coefficient of 1.24 kg CO2eq/kWh is used in the calculations as discussed in Section B.4.

Baseline Emissions (tCO2/yr) = E_B(kWh) * 1.24 kg CO2eq/kWh * 1/1000

Project emissions

Project emissions are considered to be zero, as default, as per the methodology project emissions should be considered only in case of addition of capacity to existing renewable energy project. However, as it is remotely possible that electricity demand in the project scenario may exceed the capacity of the mini/micro-hydel and the communities may purchase new diesel generator sets, to meet this additional demand. The project will monitor the purchase of new diesel generators. If new diesel sets are purchased and used, emissions from the quantity of electricity provided from these generators will be deducted from the total emission reductions.

Project Emissions (tCO2/yr) = 0 (default)
Project Emissions (tCO2/yr) = E_P(kWh) * 1.24 kg CO2eq/kWh * 1/1000 (only case of new diesel gen-sets being purchased)

Emission Reductions

Emission Reductions = Baseline Emissions – Project Emissions

B.6.2. Data and parameters fixed ex ante

Data/Parameter	Emission factor of operating diesel gensets
Data unit	kg CO_2eq /kWh
Description	This emission factor was derived from Table I.D.1 and the results of a survey carried out in 2007 of existing diesel generator sets operating in the region where the project activity is to be carried out confirmed the proposed EF to be conservative.
Source of data	Survey of existing generator sets
Value(s) applied	1.24 kg CO_2eq /kWh
Choice of data or measurement methods and procedures	Available in Annex 3
Purpose of data	Baseline/Project Emissions
Additional comment	n/a

B.6.3. Ex ante calculation of emission reductions

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The installed micro- and mini-hydropower projects are expected to have an average plant load factor of 0.50. This estimated plant load factor includes 2% of down time (175 hours a year) of the systems for repairs and maintenance. Off-grid MHP systems typically have a plant factor no more than 50% since domestic power demand is largely limited to evening and morning peak-load hours, and day time industrial load tends to be limited in rural areas. While the system sees demand close to the capacity of the power plant during evening and morning peak hours, load is significantly smaller during off-peak hours. Industrial loads will generate demand in the day time but this will vary from location to location and will tend to be limited to around a quarter of the full plant capacity in the more remote rural communities.

Baseline emissions

Annual energy baseline for 14.95 MW of generation is expected to be EB= 14,950 kW * 8,760 hours * 0.50/ (1-0.2) = 81,851,200 kWh.

Multiplying by the emission factor of 1.24kg CO2eq /kWh, we get total baseline emissions = 81,851,200 kWh * 1.24 kg CO2eq /kWh = 101,495 tonne CO2eq/ year.

The aggregated results of the calculation are given in the below table

Years	Number of plants operational*	Estimated energy production by year (GWh)	Annual estimation of emission reductions (tonnes of CO_2 e)
29/10/2009 to 31/12/2009	12	0.167	258
2010	28	2.34	3,628
2011	30	31.30	48,507
2012	90	65.5	101,495
2013	90	65.5	101,495
2014	90	65.5	101,495
2015	90	65.5	101,495
1/1/2016 to 28/10/2016	90	54.18	83,979

**Operational means projects generating emission reduction by providing electricity to the communities.*

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions ($t CO_2e$)	Project emissions ($t CO_2e$)	Leakage ($t CO_2e$)	Emission reductions ($t CO_2e$)
29/10/2009 to 31/12/2009	258	0	0	258
2010	3,628	0	0	3,628
2011	48,507	0	0	48,507
2012	101,495	0	0	101,495
2013	101,495	0	0	101,495
2014	101,495	0	0	101,495
2015	101,495	0	0	101,495
1/1/2016 to 28/10/2016	83,979	0	0	83,979
Total	**542,352**	**0**	**0**	**542,352**
Total number of crediting years	7 years			
Annual average over the crediting period	77,478	0	0	77,478

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	Energy production by each power plant
Data unit	kWh (kilowatt hour)
Description	Three phase kWh (energy) meters at each power house will measure energy supplied to the distribution system of the mini grid
Source of data	Log book placed at each power house
Value(s) applied	As per actual daily reading
Measurement methods and procedures	The power house operator will keep daily logs of kWh produced. At the end of the month, he will send this information to the AKRSP office, where this information will be compiled from all 90 project sites. All the data will be consolidated and stored in an electronic data log at the AKRSP office. The data will be regularly updated and shared with the DOE to enable verification of ERs.
Monitoring frequency	Monthly

QA/QC procedures	Regular monitoring of the schemes is carried out during and after construction by AKRSP to ensure high quality construction and sustainable operation of the MHP schemes. Power output of each plant will be verified to ensure that power output is as designed. AKRSP will carefully monitor the monthly energy production and end-uses data submitted by each of the participating communities and will provide guidance to improve the load factor and increase energy use in productive end uses. For all projects high quality three phase energy (kWh) meters manufactured by Syed Bhaies (Pvt) Ltd, Pakistan will be used in the power house to record the total power supplied to the beneficiary communities. The accuracy of the energy meters is crucial to the integrity of the monitoring process. Syed Bhaies is ISO-9000:1994 Certified by DNV International in 1999 and ISO-9000:2000 by RWTUV in 2002. Syed Bhaies energy meters are also approved by Water and Power Development Authority (WAPDA) Pakistan for its projects. According to the standard requirement of the Syed Bhaies, digital meters do not require calibration with an accuracy of +/- 1% unless any errors are reported while analogue meters requires calibration after every two years. The standard calibration methodology used by WAPDA will be used for calibration of these meters. The deduction in kWh: 1 % for digital meters and 2 % for analogue meters will be applied in case of the delay of calibration.
Purpose of data	Baseline emissions
Additional comment	n/a

Data/Parameter	**Energy production by new diesel gen set purchased in the project boundary**
Data unit	ID No. and kWh (kilowatt hour)
Description	If new diesel generator sets are purchased by participating communities in the project boundary, due to increasing demand, long-term failure of hydro plants, these will be considered as project emissions.
Source of data	A log book associated with each diesel gen set will be maintained by the operator
Value(s) applied	As per actual daily reading of kWh, when diesel gen set is used. Emission Factor for the new diesel generators will be 1.24kg/kWh
Measurement methods and procedures	The operator will keep daily logs of kWh produced through diesel gen sets. At the end of the month, the operator will send this information to the AKRSP office, where this information will be compiled for all sites, where the gen-sets are used. All the data will be consolidated and stored in an electronic data log at the AKRSP office. The data will be regularly updated and shared with the DOE to enable verification of ERs.
Monitoring frequency	Monthly
QA/QC procedures	Power output of each diesel gen set will be verified by AKRSP field engineers during routine field visits to the project sites. AKRSP will coordinate and monitor the monthly diesel gen set energy production and end-uses data submitted by each of the participating communities. AKRSP will also train the diesel gen set operators in maintaining the kWh reading.
Purpose of data	Project emissions

Additional comment	This is applicable only if new diesel gen-set are purchased by the participating communities and does not apply to the back-up generators, which are separately and uniquely identified at each site. The new generators are expected to be more efficient than the baseline generators. However, to be conservative the emission factor of baseline generators will be used for the new ones as well. Please note that the purchase of new diesel generators is a highly unlikely remote scenario that would only apply in the case of communities that might have gotten used to micro-hydropower, who would temporarily purchase and install a diesel generator to supply the community during periods when serious repairs or rehabilitation might be needed on the MHP. We do not feel this is a likely scenario and was included only at the request of the UNFCCC. The only situation where we would need to monitor the kWh of a new diesel generator would indeed be if its output would flow through the meter as used to record the power output of the hydropower plant. It would be most simple for monitoring if we did not run the output of the diesel gen set through this meter. This can easily be done by having the diesel generator output feed into the system after the meter. So in this case we would not need to monitor this output.

The Table below shows the data to be monitored:

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
1	Meter reading (electricity produced from MHPs)	Energy generated	kWh reading	M	Monthly	100%	Electronic	Crediting period plus 2 years	Data is annually reported
2	Meter reading (electricity produced from new diesel gen sets in project boundary)	Energy generated	kWh reading	M	Monthly	100%	Electronic	Crediting period plus 2 years	Data is annually reported

B.7.2. Sampling plan

>>
Not applicable

B.7.3. Other elements of monitoring plan

>>

Monitoring will consist of filling out the log book each day by the power house operator with the reading from the energy (kWh) meters, situated in the power house, for each of the 90 power plants. These readings will be submitted by the operator to the AKRSP regional office every month. The AKRSP regional office in the three areas of Baltistan, Chitral, and Gilgit will collect the data sheets, and enter them electronically for the projects in their respective regions. This information will be sent by email to the project monitoring officer in Islamabad, who will add up the energy production each month for all power plants included in the CDM project. The monitoring officer will compute annual energy production for the aggregate of all the power plants. All the data will be stored in an electronic data log at the AKRSP office. The data will be regularly updated and will be available for verification by the DOE. Monthly readings at each plant will be monitored by AKRSP and visits made to site for investigation in case of unusually high or low readings.

For all projects high quality three phase energy (kWh) meters manufactured by Syed Bhaies (Pvt) Ltd, Pakistan will be used in the power house to record the total power supplied to the beneficiary communities. The accuracy of the energy meters is crucial to the integrity of the monitoring process. Syed Bhaies is ISO- 9000:1994 Certified by DNV International in 1999 and ISO-9000:2000 by RWTUV in 2002. Syed Bhaies energy meters are also approved by Water and Power Development Authority (WAPDA) Pakistan for its projects. According to the standard requirement of the Syed Bhaies, digital meters do not require calibration with an accuracy of +/- 1% unless any errors are reported while analogue meters requires calibration after every two years. The standard calibration methodology used by WAPDA will be used for calibration of these meters.
Training will be carried out of data entry and monitoring personnel. The operators and key maintenance committee members at each project site will be trained to record the kWh in the logbook on a daily basis. AKRSP's regional field engineers will be trained to assess any malfunctioning of the energy meters and to take action on rectifying the problems. AKRSP's Regional and Islamabad Office staff members in charge of the database will receive training on entering data from log books into the database (excel sheets), electronic logging of information, analysis of this information, and production of regular reports.

Connections will be monitored of any of the micro hydropower projects, included under the CDM activity, to the grid. Any MHP that opts to connect to the national grid, which may be extended to the project area in the future, will be excluded from the project.

Leakage will be monitored by preparing an inventory of all diesel gensets being used in each community where a micro- hydropower project is being installed and monitoring that they are either scrapped or remain in the community as back-up generators after the MHP starts operation. The communities will purchase any generator for these purposes before it gets sold outside the community as per the Terms of Partnership with

AKRSP. Should any gensets be sold outside the project boundary, in violation of the TOP, the leakage emissions will be monitored by AKRSP and records kept for verification by the DOE.

It will not be necessary to monitor the actual amount of kWh produced by back up gensets which remain inside the project boundary. Any kWh produced as backup power generated by diesel gensets remaining in the communities, either during the hours when the hydel is not operational or not producing sufficient power to meet all community needs, will be considered as the component of the baseline emissions which would also exist in the project scenario and would thus cancel out. The energy from the micro-hydropower project which is not supplied to the user of the back-up generator, during its operation, will not be recorded at the kWh meter in the power house and will thus not be

recorded as baseline emissions. As the monitoring methodology being used for the project is to record the actual kWh being produced by the MHP, it will thus not be necessary to monitor the kWh produced by back up diesel gensets which remain with the project boundary. Also, please note that no diesel generators are used to start-up the MHPs as the MHP plants use small "self-exciting" alternators; thus, there is no leakage to be monitored from this source.

While the DNA has evaluated conformity with local laws and the country's environmental regulations including the rules of the Environmental Protection Agency (EPA) in the process of project evaluation for issuance of the Letter of Approval (LoA), there are currently no host country requirements for continuous monitoring of the sustainable development indicators beyond the LoA process.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>

The starting date for the project activity is 03/03/2006
(start date of physical construction of first mini hydel project - Brep).

C.2. Expected operational lifetime of project activity

>>

21 years.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>

Renewable crediting period.

C.3.2. Start date of crediting period

>>

29/10/2009(the date of registration).

C.3.3. Duration of crediting period

>>

First 7 years (renewable twice)

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
The adoption of mini hydel power units offsets diesel-based power generation in the region. This reduces GHG emissions. The project also reduces the consumption of firewood, kerosene and dry-cell batteries at the household level. The partial use of electricity for heating and cooking purposes will have direct and positive environmental impacts from reduced deforestation. The project significantly contributes to reduction of health problems associated with indoor air pollution. The negative impacts of mini-hydropower on the local environment are negligible. The small run-of-river systems do not involve storage reservoirs or inundation. No additional river bank erosion is expected at the sites as a result of the project. Ecological flow of at least 10% of the dry season flow of the streams will be retained in the river year round so there are no significant environmental effects downstream of the weirs. Accompanying afforestation activities will lead to improved watershed management. Significant forest clearing is not required for construction or transmission lines because of the small size of the developments. The visual impact of the penstock pipes is small. In order to avoid the risk of accidents from potential electrical hazards, high safety standards will be established.

The project will conform to local laws and environmental regulations, specifically the Pakistan Environmental Protection Act 1997, and the policies and guidelines set by the World Bank Group for development projects. According to the rules of the Environmental Protection Agency (EPA) Pakistan, power projects of less than 50 MW capacity are required to carry out an Initial Environmental Examination (IEE) but not the Environmental Impact Assessment (EIA), IEEs were submitted covering all 90 projects to the provincial environmental authorities in Northern Areas, for projects in Gilgit and Batistan, and in NWFP, for projects in Chitral. They have been approved by these authorities following which No Objection Certificate (NOC) has been granted for the implementation of the projects. The project will also comply with all Safeguards Policies of the World Bank Group.

D.2. Environmental impact assessment

>>
Not applicable

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>

The project follows a three-part dialogue process with the local communities. In the First Dialogue, communities are briefed about the nature of the hydropower project, the intended outcomes and mutual obligations between AKRSP and the communities. Once there is initial agreement, technical staff of AKRSP work with the community representatives to assess the available water resources, survey potential sites and prepare cost estimates. The outcome of this informs the Second Dialogue which consists of the conducting of the feasibility study. Survey results and cost estimates are presented to the full meeting of the Village Organization (VOs), and detailed Terms of Partnership (TOP) are discussed, and agreement reached. A design and cost estimation of the project is completed based on the feasibility study. Following this a general meeting of the beneficiary community will be called upon in the village premises to initiate the project (3rd Dialogue). During the Third Dialogue, terms of partnership (ToP) will be signed between AKRSP and the beneficiary community, and the first instalment of the project cost will be paid and deposited in the project

account opened by the community. First Dialogues have been conducted with all 90 communities; Second Dialogues are underway in 30 communities and Third Dialogues have been concluded with 60 communities.

Comments are invited from community members at each step of the dialogue process. The received comments, their response and agreed upon actions are compiled by AKRSP after each of the Dialogue steps. The Note for the Record has been submitted of a 3rd Dialogue carried out with community members of Ahmedabad in Hunza (Gilgit region) on May 23rd, 2006.

In addition to detailed interaction with the beneficiary community, AKRSP has had discussions about the project with several public and private sector partners. These are other local stakeholders in the development of the hydropower projects. Discussions have so far been held with the Northern Areas Public Works Department (NAPWD); the Planning and Development Department (P&DD), Pakistan Poverty Alleviation Fund (PPAF), Acumen Fund, Alternative Energy Development Board, and the Pakistan Council for Renewable Technology (PCRET). These discussions are recorded by AKRSP.

The host country DNA does not have any specific requirements for public consultation as a requirement for project approval other than what is included in the IEE/EIA process. The provincial environmental authorities require reporting on stakeholder consultation while completing the Initial Environmental Examination. They have been satisfied with the reporting by AKRSP on its stakeholder consultation process described above and have issued the No Objection Certificate (NOC).

E.2. Summary of comments received

>>

The comments received from beneficiary communities have in generally been highly encouraging. Communities are very interested in moving ahead with the projects. However they do have comments and questions concerning the details of the project. Comments received include the following:

1. Who will provide the land for the construction of project related structures?
2. Which construction cost components will be covered by the community and which by AKRSP?

3. Who will be responsible for project management and maintenance after completion of the project? Who will take care of large repair costs?
4. What will the tariff be for the provided electricity?
5. Will the hydropower project interrupt irrigation in the fields?

The meetings with the public and private sector partners have resulted in the following actions:
1. The NAPWD has revised the Northern Area Government's Energy Strategy, and incorporated CDM as an additional objective. It now allows local NGOs and community organizations to invest in hydropower projects below a certain threshold and to develop them as CDM projects.
2. PPAF has signed an MOU with AKRSP to provide 34% of the total project funds for the project.
3. PCRET will sign an MOU with AKRSP and channel its technical resources, including providing new technology and research and development support to AKRSP for this project.
4. Acumen Fund is carrying out due diligence and is considering providing both equity and debt investment into the project.

E.3. Consideration of comments received

>>
Comments and questions from the beneficiary community are responded to during public meetings. All outstanding issues are resolved before the Terms of Partnership is signed between AKRSP and the participating community. Supporting document (Note for Record) of Third Dialogue with Ahmedabad community in May 2006 provides an example of the types and clarifications and conflict resolution which might typically take place during such meetings.

SECTION F. Approval and authorization

>>
The application of the baseline study and monitoring methodologies was completed by Winrock International, Pakistan together with Engineering Section of AKRSP, on 31/10/2008. Contact information for the responsible person is given below.

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Appendix 2. Affirmation regarding public funding

AKRSP is finalizing partnership agreements with:
1. Pakistan Poverty Alleviation Fund (PPAF) for grant financing of $6.000 million.
2. Pakistan Centre for Renewable Energy Technologies (PCRET) for grant financing of $3.33 million to purchase capital items such as turbines and generators for 80 units.

Written commitments will be shared as they become available.

Appendix 3. Applicability of methodologies and standardized baselines

BASELINE INFORMATION

Results of Survey Carried out to Find out the Emission Coefficient of Diesel Generator Sets Currently used in the NAC Region

A team of 6 engineers from the three regions (Gilgit, Baltistan and Chitral, Northern Pakistan) of AKRSP carried out a questionnaire survey of diesel generators currently being used in the regions, where MHP investments are proposed. As operating diesel generators in the region mostly serve town centres rather than rural areas, few of them will actually be replaced by the planned micro-hydropower plants. However, it is expected that generators which would eventually serve the locations in the absence of the micro-hydropower projects would have similar or higher emission coefficients as documented in the survey. The ranges of diesel generator sets (gensets) sampled fall under the following categories: a) < 15 kW; b) >=15 <35 kW; c) >=35 <135 kW; d) >=135 <200 kW; e) >= 200 kW to be consistent with Table I.D.1 as per the small scale methodology for Type I – Renewable Energy Projects Section I.D. 'Grid connected renewable energy generation'. An attempt was made to survey 10 generators from each of the three areas for each of the five above categories. The surveyors were also instructed to the extent possible to survey gensets outside the municipal area to get a more realistic sample of generators that would likely be used in the more rural communities. As there were unlikely to be any generators outside the municipal areas in categories >=135 <200 kW and >= 200 kW, at least two generators in each of these categories would be sought for the survey in each of the three regions.

A total of 50 well filled out questionnaires were analyzed after some of the questionnaires received were discarded as they were incomplete or had obviously wrong information. They are broken down as follows:

Category	Number of Questionnaires received
< 15 kW	23
>=15 <35 kW	13
>=35 <135 kW	9
>=135 <200 kW	2
>= 200 kW	3
Total	50

The methodology used was to measure the fuel efficiency of the gensets in terms of the number of kWh they produced per litre of diesel. This was done by filling up the diesel tank, running the generator at normal load for a few hours. The amount of diesel used was computed by measuring the amount of diesel needed to fill up the diesel tank a second time. The amount of electricity generated was noted by taking the before and after readings on the kWh meters.The fuel efficiency (kg of diesel required to produce 1 kWh of electricity) was then multiplied by the factor of 3.2 kg CO2eq per kg of diesel following the revised 1996 IPCC Guidelines forNational Greenhouse Gas Inventories to arrive at the emission coefficient of the diesel gensets.

The results of the survey are given in the table below. The fuel efficiency for each category of gensets is computed as a simple average, without taking into account the different amounts of energy each genset is likely to produce on account of its size. It can be seen clearly that the smaller gensets have significantly lower efficiency and correspondingly higher emission factors than the larger gensets. The majority of generators currently used in the more rural locations similar to where the MHP projects are planned to be located are in the first category < 15 kW with a few institutions like banks, hospitals, schools, and NGOs using gensets in the second category >=15 <35 kW. If we take a simple average between these first two categories of gensets we arrive at an emission coefficient of around 2.04 kg CO2eq/ kWh.

Category	Measured fuel efficiency (kWh/litre)	Litres of diesel/ kWh	kg of diesel/kWh	kg CO_2eq/ kWh
< 15 kW	1.19	0.84	0.70	2.25
>=15 <35 kW	1.47	0.68	0.57	1.82
>=35 <135 kW	1.73	0.58	0.48	1.55
>=135 <200 kW	2.78	0.36	0.30	0.96
>= 200 kW	3.03	0.33	0.28	0.89
Weighted average of gensets <35 kW	1.47	0.68	0.57	1.83

The weighted average can also be taken of the 23+13 = 36 gensets in these first two categories. This is done by taking an average after multiplying the computed emission coefficient of each generator by its size to account for the amount of energy the generator can produce. This would be a more conservative approach as it would provide higher weightage to the larger generators. The emission coefficient computed in this way comes to 1.83 kg CO2eq/ kWh. This is shown in the last row of the table above. This emission coefficient based on the survey is higher than that used in Section B.4 to compute the project baseline of 1.24 kg CO2eq/ kWh, which was based on Table I.D.1.

Appendix 4. Further background information on ex ante calculation of emission reductions

Not applicable

Appendix 5. Further background information on monitoring plan

Monitoring Information

Monitoring will consist of filling out the log book each day with the reading from the energy (kWh) meters, situated in the power house, for each of the 90 power plants. High quality three phase energy meters will be used to record the kilo-watt-hours (kWh) supplied from each power house to the beneficiary communities. The readings of the completed month will be submitted by the power house operator to the AKRSP regional office within the first week of the new month. The AKRSP regional office in the three areas of Baltistan, Chitral, and Gilgit will collect the data sheets, and enter them electronically for the projects in their respective regions. This information will be sent by email to the project monitoring officer in Islamabad, who will add up the energy production each month for all power plants included in the CDM project. The monitoring officer will compute annual energy production for the aggregate of all the power plants. All the data will be stored in an electronic data log at the AKRSP Islamabad office. The data will be regularly updated and will be available for verification by the DOE. The relevant data records will be kept with AKRSP in electronic data log for 2 years beyond the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later.

Quality Assurance

AKRSP will provide technical support in the feasibility study, project design, equipment procurement, construction supervision of the micro- and mini-hydropower projects, and in the training of the operators and electricity users. AKRSP charges 12% of the cost of the project for these services. This means that while the project is implemented by the community, there is strong quality control by AKRSP on all technical aspects of the project. This has proven to be a tried and tested mechanism for building and operating over 200 high quality MHP plants in the NAC region. For power projects included in this CDM project activity, commissioning will also include power output verification by AKRSP to make sure that the equipment can produce the full power it was designed for.

For all projects high quality three phase energy (kWh) meters manufactured by Syed Bhaies (Pvt) Ltd, Pakistan will be used in the power house to record the total power supplied to the beneficiary communities. The accuracy of the energy meters is crucial to the integrity of the monitoring process. Syed Bhaies is ISO- 9000:1994 Certified by DNV International in 1999 and ISO-9000:2000 by RWTUV in 2002. Syed Bhaies energy meters are also approved by Water and Power Development Authority (WAPDA) Pakistan for its projects. According to the standard requirement of the Syed Bhaies, digital meters do not require calibration with an accuracy of +/- 1% unless any errors are reported while analogue meters requires calibration after every two years. The standard calibration methodology used by WAPDA will be used for calibration of these meters.

Regular monitoring of the schemes is carried out during and after construction by AKRSP to ensure high quality construction and sustainable operation of the MHP schemes. AKRSP is carefully monitoring the monthly energy production, status of diesel generators and end-uses data submitted by each unit and providing guidance to improve the load factor and increase energy use in the productive uses.

The deduction in kWh: 1 % for digital meters and 2 % for analogue meters will be applied in case of the delay of calibration.

Training of key personnel will be carried out to ensure accurate data entry and its proper monitoring. The operators and relevant maintenance committee members at each project site will be trained to record the kWh in the logbook on a daily basis together with information on operating hours, voltage, and current of the project every hour.

AKRSP’s regional field engineers will be trained in analyzing the power output data (voltage, current, kilowatt readings by the hour) in the log books to assess possible malfunctioning of the meters. They will also be trained to identify any problems with current transformers or the meters themselves and on actions which must be taken to remedy these.

AKRSP’s Regional and Islamabad Office staff will provide the training to the operators and maintenance committee members. These staff members will receive training on entering data from log books into a database (Excel Sheets),electronic logging of information, analysis of this information, and production of regular reports.

Internal Verification

Monthly kWh readings at each plant will be monitored both by the engineering teams at each of the regional offices responsible for supporting the energy projects and by the monitoring officer at the Islamabad office of AKRSP. In addition to regular visits made by the regional team to sites, special trips will be made to specific sites for investigation in case of unusually high or low kWh readings. The energy meters will be certified by a reputable agency every two years or as needed if readings are found to be unusual at any site. In addition to kWh readings, the daily log books at the power house will also record the voltage, current, frequency, every hour and any incidences of breakdown during the course of the day. This information will be available at the power house for the AKRSP engineers to check when they visit the site.

Corrective actions will be taken to ensure that the highest standards of monitoring are maintained. Should the operator observe any deviation in the daily energy supply readings at the power house, he will inform the Regional Manger Engineering in the nearest AKRSP regional office. The Regional Manager will immediately send the concerned field engineer to the site for further verification and to take necessary corrective action. The field engineer will first verify from the analysis of the data in the log book that there is indeed an error in the meter readings. He will then identify the problem and ensure either the necessary repairs or replacement of current transformers or the meter, if needed, in consultation with the concerned maintenance committee of the project. In addition to monitoring by the operator, the three Regional Engineering Managers and the Programme Manager Engineering in the AKRSP Islamabad office will both regularly review and verify the energy supply data coming from the power plants and will initiate corrective action if the energy production from any of the power house meters appear to be abnormal.

The monitoring plan will include verification of connection of any micro/mini hydropower project to the grid. Any MHP that opts to connect to the national grid, which may be extended to the project area in the future, will be excluded from the CDM project activity.

Leakage

No electricity generating micro-hydel equipment which has been used elsewhere will be transferred into the project boundary. All 90 projects will use newly manufactured turbines, governors, and penstock pipes.

Existing diesel generators operating in each community, where a micro- or mini-hydropower project is being installed, will be recorded. Based on the agreement reached with the community, old gensets will be scrapped and newer ones will remain in the communities to be used for back-up power. The communities will purchase any generator before it gets sold outside the community. Should gensets be sold outside the project boundary by any community members, in violation of the Terms of Partnership, any leakage emissions will be monitored by AKRSP and records kept for verification by the DOE.

Appendix 6. Summary report of comments received from local stakeholders

Not applicable.

Appendix 7. Summary of post-registration changes

Changes to project design of registered project activity

The PRC-1713-001, approved on 07/10/2014, considered the following changes:

1. After the 1st Verification visit, the PDD has been revised and revisions were approved by the UNFCCC on 13 September 2012. Initially 103 Microhydel power plants had to be constructed, but after the revision of the PDD, 90 mini and micro hydel power plants will be constructed without exceeding 15 MW cumulative generation capacity.

2. 160 kW generator has been installed in the hydro power project “Doko (Serial No. 23 in the PDD)” due to the unavailability of 150kw generator as originally stated.

3. The planned capacity of hydro power project “Bulachi (Serial No.68 in the PDD)” has been changed from 75kW to 65kw, since the project site requires a smaller capacity of generator due to limited access by any type of transportation.

The PRC-1713-002, considers the following changes:

4. The planned capacity of hydro power project “Ahmedabad” (Serial No.11 in the PDD) has been changed from 400kW to 350kw from 09/09/2015. The reason for such situation is because the old alternator was replaced due to technical fault hence the capacity was changed to 350 kW from 400 kW,

Corrections

The PRC-1713-001, approved on 07/10/2014, considered the following corrections:

1. The name of hydropower project is corrected as the “Yourjogh (Serial No. 38 in the PDD).”

Permanent changes from registered monitoring plan or applied methodology

The PRC-1713-001, approved on 07/10/2014, considered the following permanent changes:

1. The Calibration requirement for installed energy meters is confirmed with the Syed Bhaies (Pvt) Ltd, Pakistan in the following;
   - Digital meters once installed and calibrated are not required calibration unless any errors are reported; and
   - Analogue meters will be calibrated once they will achieve two years of use and/or detection of any error in readings.

   The deduction in kWh: 1 % for digital meters and 2 % for analogue meters will be applied in case of the delay of calibration.

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Document information

Version	*Date*	*Description*
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.

Version	*Date*	*Description*
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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