



# **SOLAR POWERED HOSPITAL AND UNIVERSITY BUILDING IN HELMAND**

**Demonstration of a financing model for  
renewable energy deployment in a fragile context**

MARCH 2017

## The project

Mercy Corps has piloted a Build-Operate-Lease-Transfer of Ownership (BOLTO) model on a 60kWh off-grid solar PV hybrid system to power a university campus and hospital in the Helmand province of Afghanistan. This project was implemented with Bost University & Hospital (BUH), a privately run facility located in Lashkar Gah City provincial capital of Helmand, installed on behalf of Mercy Corps by Sustainable Energy Services International (SESI) and funded by the UK Department of International Development (DFID) with the coordination and support of the Ministry of Energy and Water (MEW) and the Afghan electricity utility company Da Afghanistan Breshna Sherkat (DABS).

With pre-financing funded by DFID, Mercy Corps was able to provide patient funds for the capital investment needed to install the system composed of solar panels, battery and remote monitoring system. The project has demonstrated the business model viability in this fragile market, and Mercy Corps is planning to reinvest the loan capital into additional renewable energy initiatives.

The university and hospital facilities that previously were predominantly powered by a diesel generator have reduced their diesel usage tremendously to approximately 1 to 2 hours a day). The system was switched on 3 Nov 2015. Since January 2016, monthly payments amortize the initial investment within 36 months repayment period. At the end of this period the recouped initial capital will be revolved to other renewable energy projects, using the same lease-buy contract business model. Further, once the system costs are repaid BUH will have virtually free electricity, which will accrue significant savings over the remaining useful life of the asset, estimated to be 17 years.



## System characteristics



*“Solar radiation is plentiful in Helmand, solar power is silent and clean as we want our clinic to be: a direct fit with our principles and values” Mr. Kazim, hospital manager*

Photo credits: Bost Hospital and University

The 60kWh Solar PV System (SPVS) comprises 240x250 Watt peak panels, 48x1500 Ah 2v battery cells as power storage and hybrid backup connection with one of two existing diesel generators. The system performance is tracked remotely every 10 minutes by a monitoring unit accessible over the Internet. The central control unit automatically integrates inputs from PV panels and the diesel generator to balance power demand and generation, particularly when there is significant lack of solar irradiance. The system is installed

on the roof of a five-storey building, which accommodates BUH. Each panel is mounted on a galvanized steel adjustable frame with 10 panels per frame. The frames are facing south and can be adjusted down to 20 degrees to the horizon during summer and up to 45 degrees with the horizon during winter. This adjustable tilt maximizes the exposure of the panels to the seasonal irradiance levels in Lashkar Gah and thus maximizes the energy yield from the system.

## Energy access

Access to electricity for residences and businesses is very limited in Afghanistan, especially in rural districts: “Afghanistan’s per capita power consumption (as measured from grid supply) is among the lowest in the world at about 27 kWh per year. Less than 10% of the population currently has access to electricity. Over 85% of the country’s fuel needs are met by burning wood” (Afghan Investment Support Agency - AISA). The MEW and DABS are setting ambitious but essential goals for the deployment of SPVS and other renewable energy technologies to address this shortfall. A major constraint for achieving this goal is the dearth of investment capital needed to finance deployment of SPVS, at grid, mini-grid and off-grid scales. This project illustrates, through using donor funding as patient capital, a business model that can be utilised to scale-up the deployment off-grid scale decentralised systems.

Investment in power supply is listed as one of the top sectors for economic growth by the AISA. Relying purely on the low national grid expansion to access rural areas is likely to be expensive and cost prohibitive for many customers. For this reason, the national energy strategy prioritizes decentralized power supply for remote areas.

The falling costs of SPVS coupled with the high cost of diesel generation and intermittent reliability of grid-supplied electricity in Afghanistan provides an incentive to drive deployment. However, the added costs and risk of doing business in the fragile Afghanistan market dissuade private investment. The fragile security environment in Helmand Province was indeed a major challenge. As a key example, the entire panel array of the system had to be dismantled during October 2016 when fighting got too close to the city and bullets were reaching the university building. One panel got damaged. To set the system back once the situation stabilized again, a SESI engineer was called from Kabul who also provided a re-wiring diagram as a contingency for future emergencies.

Afghanistan requires private investment capital that is more risk prone to provide the resources for scaled deployment. The demonstration value of this project is a foundational step toward showing that it is possible to identify private power consumers willing and able to manage and operate solar PV technology on a full



*Solar is good for business and quality of care*

Photo credits: Bost Hospital and University



cost recovery basis, so long as an intermediary like Mercy Corps can act as a finance and technical support intermediary.

This project utilized DFID donor money as patient capital to fund the deployment costs of solar energy in a fragile market that is underserved by commercial investors with a low risk threshold. This is a step in the right direction to demonstrate the viability of renewable energy solutions that reduce costs, improve the service and save carbon emissions. Further, the donor capital provided by DFID is returned enabling it to be used for financing deployment of more systems of similar size to customers who demonstrate the willingness and ability to repay through a BOLTO model.

## Financial Sustainability

The capital value of the system of USD 185,000 is being repaid through 36 monthly instalments under a BOLTO contract. This contract is between Mercy Corps and the BUH and is financed through savings in avoided diesel fuel consumption. At the end of the lease-to-buy contract, the ownership of the system will transfer to BUH. The system was switched on in November 2015, shifting a monthly diesel generator fuel bill of between 4,000 to 5,000 USD to a payment of 4,112 USD that goes toward repaying the SPVS capital investment. In addition to the financial asset being purchased by BUH, the university and hospital facilities also now benefit from less noise and air pollution, and greater reliability of electricity that assists with better educational and healthcare services being provided.

## The partners

Mercy Corps' partners in the project were, BUH, SESI, the MEW and DABS.

The **Bost University** was founded in 2012 and established using private investment from a Helmandi businessman, Mr Ahmad Jan Popal. Students' attendance numbers have grown since to approximately 1,800 in 2016, which include 385 young women. Helmand is a very conservative province and had been a Taliban stronghold before OEF<sup>1</sup> in 2001. Education under the Taliban was actively discouraged and providing education to women was even more restricted. Mr Popal has introduced very progressive measures aimed at improving women's access to education, such as dedicated transport service, separate classrooms and facilities and engaging mature female teachers. These actions have met and overcome resistance from the local culture. The university offers a range of tertiary courses the main fields including, Business Studies Law, Engineering, Medicine, Midwifery, Nursing Laboratory Technician, Pharmacy, and Computer Science. In 2014, the structure expanded to include a private hospital offering 24/7 all year round much needed medical services to the community and offering students a way to increase their qualification. Patients are required to pay although discounts are offered to vulnerable families. BUH has recently received approval from Ministry of Higher Education to introduce an agricultural studies faculty at the



Photo credits: Bost Hospital and University

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<sup>1</sup> October 7, 2001 - Operation Enduring Freedom started in October 2001 by president George W. Bush and British forces with airstrikes on Taliban and al Qaeda targets in Afghanistan

university and intends to expand the service offering in the second half of 2017. BUH is also exploring ways it can supply surplus SPVS electricity to agricultural processing business in the nearby market.

The Afghanistan branch of **Sustainable Energy Services International** – is the domestic engineering company that installed the system. Through valued collaboration with SESI many installation and operations and maintenance challenges were overcome.

**Ministry of Energy and Water (MEW)** – is the lead government body for granting permissions and guidance regarding the policy environment for renewable technology. The ministry is responsible for setting the enabling environment to increase private sector participation and, aware of the project's demonstration value actively supported it.

**Da Afghanistan Breshna Sherkat (DABS)** – is the commercialized, government owned, entity responsible for the generation, transmission and distribution of main-grid electricity. The organization has long-term strategic plans to bolster the production of large-scale renewable electricity mainly from solar PV and hydropower, and managing reduced reliance on imported and generator electricity. It was also interested in the effectiveness of this project to promote solar technology in fragile provinces of Afghanistan to address constraints on electricity supply.

## Socio-economic impact

Prior to installation of the hybrid PV system, BUH's building received electricity from two generators that were affected by frequent malfunctions and required a technician to maintain. These generators were required to overcome at the time the underserved electricity supply from DABS.



Photo credits: Bost Hospital and University

According to the university manager, Mr. Kazim, the generator used to run from 8 am to 6 pm, while now the time available for students at the library, that gives access to digital textbooks and computers, has been extended to 10pm. The laboratory is also

constantly open for educational purposes as well as to perform medical tests.

Crucially, the medical staff now have constant access to power. The hospital receives in average 30-35 patients per day, mostly women. The busier months are in the summer due to higher cases of food poisoning likely due to lack of refrigeration in the province, and in the cold winter months due to pneumonia. In addition, the hospital has a midwifery practice that also performs deliveries. These and other surgical procedures require proper lighting.

Mr Kazim notices that switching to solar energy has enabled the elimination of generator noise and improvement of air quality. Smoke and exhaust gases used to pollute everything, including the surgical equipment that had to be continuously sterilized. Nurses had a hard time to keep the medical coats pristine white due to the soot from the generator. Sound pollution was as bad as air pollution and patients had to endure the constant noise of the generator running. Both affected the quality of care of the health facility.

Solar power instead helps the hospital to provide a better service ensuring a higher standard of care. This aspect has an added ethical value for Mr Kazim that strives to provide the best for his patients.

## **》 TWO EPISODES ILLUSTRATE VIVIDLY WHAT IMPROVEMENT THE NEW SYSTEM HAS MADE.**

*“One night a patient needed extensive blood tests (10 different types) ordered by the doctor. Setting up the generator would have required recalling the technician who had left for the day, an operation that would have taken easily 3 hours. With the solar system all was done very quickly”.*

*“I remember a doctor shouting in the corridor, the scalpel in his hand, that he needed electricity. The generator, located in the basement, had stopped working. The doctor had to grab a torch and run back to the surgery room to continue to operate”*

Interview with Mr. Kazim, 10 January 2016

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Another benefit from solar power is related to energy security. Helmand province is affected by conflict, where opposite factions are continuously trying to undermine each other’s position and the electric grid has been deliberately targeted numerous times. BUH’s island of power operates within this unstable context, providing a coping mechanism that makes electricity services more difficult to disrupt. According to Mr. Popal is it “actually a godsend that will make people love engineers”.

## **Impact on CO2 reduction**

The diesel generator powering the university/hospital structure before the installation of the solar system used to run from 8am to 6pm every day. The average consumption of fuel amounted to 19.8 liters per hour or 6,022 liters per<sup>2</sup> month. The estimated CO2 emissions avoided by the project are approximately 170 Mt CO2 per year<sup>3</sup>.

## **Innovation potential for replication and upscaling**

FURTHER IMPROVEMENTS ON BUH SYSTEM.

The system could benefit from further improvements. These include renewing the wiring inside the building and installing energy efficient lights (LEDs) and appliances. This upgrade will allow extending electricity availability from the actual 10pm to 2am or 3am. According to Mr. Popal, the estimate cost is around USD 11-12,000 and works will be completed in a couple of months.

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<sup>2</sup> (75% load) x 10 hrs. Per day x 365 / 12 = 72,270 l per year = 6,022 l per month

<sup>3</sup> <https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>. If we use the section on “Gallons of gasoline consumed” of 8.887kg/ US Gallon (3.78541litres) then it is 2.35kgCO2 per Liter of diesel consumed. At 72,270litres per year @ 2.35kgCO2/ liter = 170MtCO@ per year avoided CO2 emissions

## REPLICATION IN SIMILAR CONTEXTS.

Whilst the context specific focus is on Afghanistan, this case study elucidates features that are common to fragile or thin renewable energy supply markets such as: underdeveloped supply chain; poor economies of scale leading to high marginal costs of SPVS deployment in that supply chain; and nascent knowledge and skills within the industry.

For example the highly volatile security situation in Afghanistan has been a contributing factor to the current poor functionality of the market and poses legitimate concerns in the minds of investors. This is a non-technical barrier to adoption and a constraint on scalability. These perceptions, which inhibit private investment support, can be ameliorated to some degree through a successful demonstration project. There is immense value to be gained through experiential learning from testing the business model in such a real-life demonstration. In such fragile markets this is only possible using donor funding.

## DEMONSTRATION VALUE

The courage and experience of Mr. Popal can serve as example to others. Mr. Popal has been hesitant to put forward such a significant investment, even if he had seen similar solutions applied in other countries, still did not know whether it would be applicable in his region. His positive experience has already started to work as catalyzer for others to follow the same path. The initial skepticism has been dissipated by the display of tangible benefits that solar panels have shown.

## UPSCALE FUND

Mercy Corps, coordination with MEW and DABS, is planning to utilize the capital that is being repaid as rolling fund for other similar projects. To this end, Mercy Corps has established a blended finance product (investment fund) for leasing Solar Photovoltaic Systems (SPVS) in fragile regions of underserved countries where sizeable population segments live entirely off grid. The proposed fund will be combined with capacity development and regulatory support to government to leverage donor funding and help reduce the risk of entry of private capital. The product will distribute the cost into affordable instalments and, where appropriate and feasible, will be design for Shari'a compatibility.



## VIDEO

<https://drive.google.com/file/d/0BxWancQi18SwMnB4Wk5EcTJsTWM/view>

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### About Mercy Corps

Mercy Corps is a leading global organization powered by the belief that a better world is possible. In disaster, in hardship, in more than 40 countries around the world, we partner to put bold solutions into action — helping people triumph over adversity and build stronger communities from within. Now, and for the future.



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