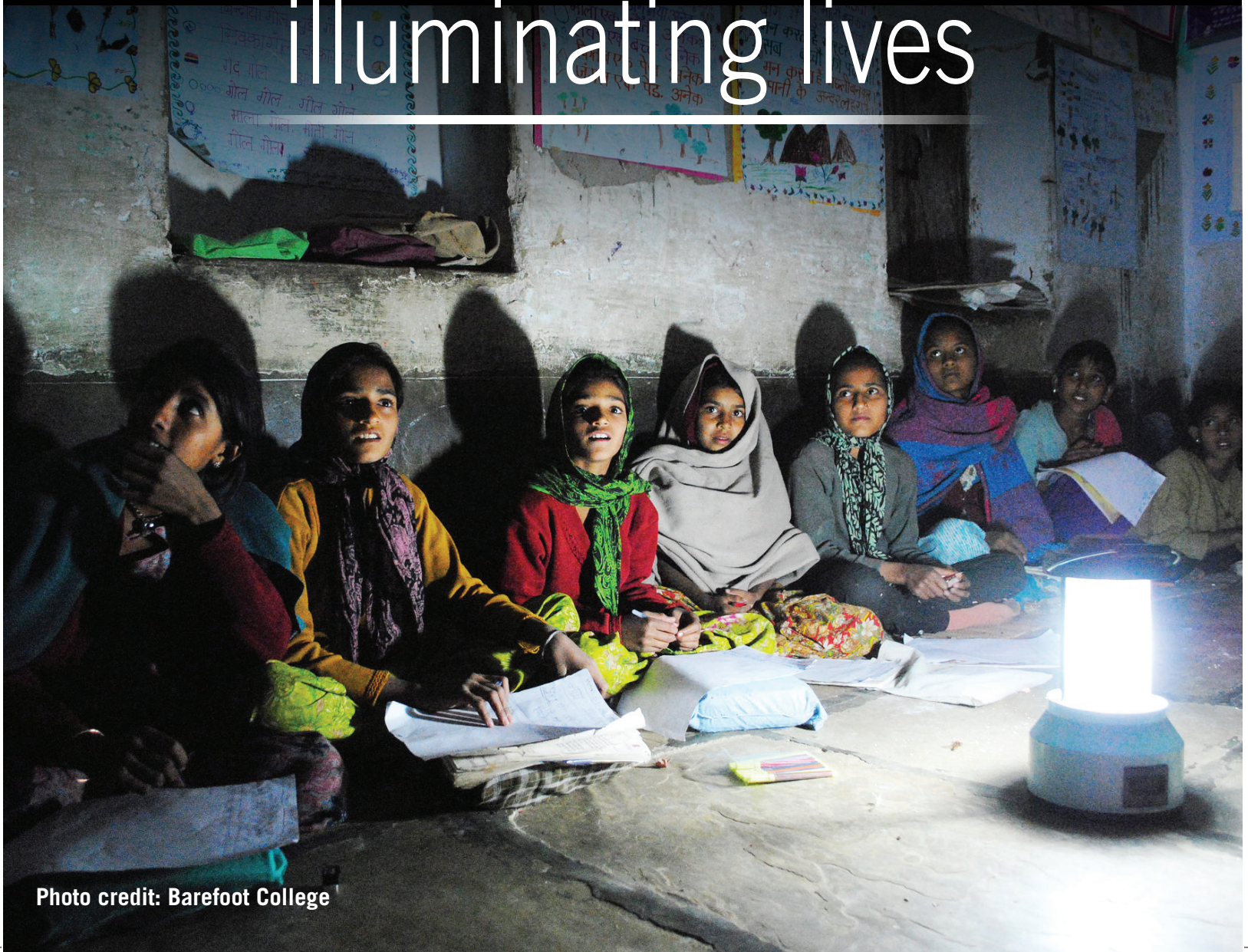


# SOLAR POWER

illuminating lives



A photograph of solar panels in a field under a cloudy sky. The panels are tilted and arranged in rows, with a grassy field in the foreground and a blue sky with white clouds in the background.

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# Foreword



The purpose of this booklet is to throw cerebral light on some connecting issues for regulators to consider. Life is no longer liveable in isolation, the socio-economic, cultural and ecological realms are all interconnected. Regulation is after all, the art of creating a balance between the 'haves and the have nots' so that we bring about inclusiveness in India's growth story.

These inspiring stories from around the world and India demonstrate that for infrastructure to develop in a sustainable manner profitability must be ensured for the private sector, while at the same time, ecological and social parameters must be met. These stories from the realm of Renewable Energy are living proof that this can be achieved.

A handwritten signature in black ink, appearing to read 'Harry Dhau'.

Harry Dhau  
Director General  
IPPAI



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Photo credit: Relief International Jordan

# A solar kiosk reigniting hope for a few in Za'atari refugee camp

*"Look at how a single candle can both defy and define the darkness"*

--- Ann Frank

*\* In collaboration with Relief International Jordan*

**T**he Syrian conflict has been regarded as one of the worst human conflicts in the 21<sup>st</sup> century human history in which death and destruction has been rampant. Around 400,000 Syrians are estimated to have lost their lives in this ongoing conflict and about 11 million have been displaced from their homes, seeking refuge in other nations. In its bordering country, Jordan, now Syrians comprise of a sizeable population with approximately 1.2 million Syrians living in Jordan which is twice the number of the registered refugees. A large number of them have been relegated to the refugee camps, principle among which are Za'atari and Azraq, with Za'atari currently accommodating over 80,000 refugees. This makes Za'atari the fourth largest city in Jordan and an area of growing concern for the nation.

Electricity in Za'atari is a privilege. Power supply to Za'atari inhabitants is provided for by the Jordanian Government and the Office of the United Nations High Commissioner for Refugees (UNHCR) from the grid which costs around 42 cents per kilowatt-hour. This has been a very costly affair for the UN which at one point of time was paying around \$ 800,000 per month to provide electricity to the camp inhabitants. It is imperative to note that electricity is provided only between 7pm in the evening to 5 am in the morning which is only the official timing. Electricity usually makes an appearance between 8 pm and lasts till 1 am. It is during this crunch period that the camp inhabitants must complete all their primary tasks such as cooking, cleaning, charging of appliances and even



Photo credit: Relief International Jordan

studying. Some refugees wait the entire day for these 5 hours of power availability to hear some news about their relatives and loved ones fighting for survival back home in Syria.

Like many other international humanitarian organizations, Relief International in partnership with United Nations International Children's Emergency Fund (UNICEF) is providing education services to the refugees in Za'atari and has educated over 28,000 people till date. Without electricity, this has not been an easy task. During the summers, in a desert setting, there is a lack of cooling creating a very oppressive learning atmosphere for the children. No appliances required for the teaching programs can be charged. Problems exacerbate during winters. Sunlight fades from around 3 in the afternoon which is the time for informal education of those children who cannot manage to attend classes in the morning as they are mostly child laborers (13% out of the total number of children) working inside the camps for a paltry sum of money for their families who also form one of the most vulnerable groups in the camp. During winters when darkness sets in early, extending learning to them in absolute darkness has made life very frustrating for both the organization as well as the children. For most parents, sending their daughters to school during winters in the afternoon is out of question as they have to walk a considerable distance to reach school in absolute darkness due to lack of any street lighting. But things have taken a new course of late. Sunkiosk, a German energy company made a donation to UNICEF and offered to set up a solar kiosk in one of the Relief International's education centre. The kiosk is intended to produce an output of 8 kWh, which is expected to drop to 5.5 kWh during the winter but reach highs of 14 kWh in the summer. The beneficiaries include everyone involved in that particular centre i.e. students, volunteers and teachers that amount to nearly 800 people. This kiosk helps charge up to 30 solar light bulbs which can then be hung inside the classrooms to light up the classrooms after dark for conducting the informal education lessons availed by those working children who cannot afford to attend classes during the day. Other than light bulbs, the kiosk is proving to be valuable in powering other appliances such as tablets and printers which are used both for classroom activities as well as the RI staff members during their operation in the centre, effectively reducing the load on the generators. A mobile phone is the principal means through which the refugees can stay in touch with their loved ones back home in Syria. The kiosk has enabled the students, teachers as well as volunteers to keep their mobile phones charged which they otherwise had to pay to certain shops to get done. Most importantly, the centre has become that one point of illumination where community gatherings can take place such as women health club gatherings in the evenings, where they receive training on health issues and family planning by the volunteers. Although the dependence on the diesel powered generator is still high, the arrival of the kiosk has lessened its load and has been responsible for a cleaner environment for those in the centre. Most importantly, it represents something bigger; that hopes for a better life can and will continue to exist even though within the confines of barbed wires and high walls.



Photo sourced from Aziza's Place; facebook

# Solar powered tuk tuks changing journeys in Cambodia

*“Success is to be measured not so much by the position that one has reached in life as by the obstacles which one has overcome”*

--- Booker T. Washington

An old Khmer saying reads “Men are gold, Women are cloth”, establishing the watertight cultural compartmentalization of the purpose of the ‘fairer’ gender. Not much has changed for Cambodia’s women post the bloody civil war despite the fact that in a rare case for the region, the sex ratio in Cambodia is favourable towards women. A large number of women continue to live in squalid conditions below the poverty line, are vulnerable to abuse, draw extremely low wages, suffer illiteracy and remain grossly underrepresented in the nation’s economy.

An NGO named Aziza’s Place operating in Cambodia, found a small but very creative way to empower a few women by deploying the power of solar technology and an ingenious business strategy. A group of women were identified from dumpsite communities who picked recyclable items from garbage for a living in Phnom Penh earning a paltry sum of \$5 a day. The act of manually sorting and picking out garbage every day is not only a physically daunting task but a dangerous one as it exposes them to the vulnerabilities of the street and the toxic and hazardous environment of the city dumpsite. This, in addition to the fact that there is no parity between the daily wage earned at the end of the strenuous task and its ability to feed the families of the female

workers many of whom are single mothers struggling to feed and educate their children alone. The NGO which is a children's' charity in Cambodia, understood that the development of children in isolation from a change in lifestyle of their parents will not amount to their holistic development. It is with this vision in mind that a well-rounded approach was designed: lifestyle change (social impact) of parents especially women from vulnerable dumpsite communities through innovative business solutions while also sensitizing Cambodians about the environment and clean energy.

The means lay with the sun and technological innovation heralded by an Australian manufacturing firm called Star8 which have manufactured solar powered and electric vehicles, precisely 'tuk tuks' in Cambodia and have sold it to Aziza's Place. The solar panels mounted on the tuk tuk generate enough power to run upto 75 miles with a speed of 35 miles per hour. The solar powered tuk tuk design was specifically tweaked to accommodate a mini business with internal shelves and a collapsible driver's seat. Thus, not only does this solar powered tuk tuk represent a clean mode of transportation but is operational with an inbuilt capacity to provide other value added services such as storage.

Today, Aziza's Place's solar tuk tuk is seen selling coffee and fresh fruit juices in one of the busiest street of Phnom Penh. The small enterprise is managed entirely by women who used to work on the dumpsites as their lack of education, social exclusion as well as economic circumstances excluded them from the possibility of being involved in better means of earning an income. The women were trained to drive the tuk tuks which is another gender based stereotype that was broken, learn customer service, kitchen hygiene, culinary skills as well as trained in English language. This sounds easier said than done since these women were illiterate and started to learn some basic literacy skills only when starting to train with the NGO. It was in fact, the ambition and self- motivation of the women to change their lives that made the task of the NGO easier. This mini enterprise is also spreading a crucial message by integrating clean practices into its business strategy. Customers get a discount on their coffee in exchange for plastic bottles or aluminum cans. The practice also serves as an educational tool to help people realize the value that even garbage holds which when simply discarded ends up in dumpsites, making the connection in their strategy for environmental and social impact come full circle. The solar tuk tuks ideally employ 3 women with the potential for each employee to earn approximately \$ 180 a month.

Cambodia remains one of the poorest in South East Asia, plagued with a highly unreliable power supply and expensive grid electricity. Energy experts see solar power as having limitless potential in Cambodia. Not only will it provide a sustainable solution for the country's power sector woes but also help save the rich natural environment of the nation which is today getting rapidly depleted due to the large scale hydropower and coal fired projects. Most importantly clean, affordable and sustainable source of electricity will bring what is most important for a nation's development, a sense of empowerment to those who most require it.



Photo sourced from <http://www.nevadaindianterritory.com/>

# Moapa Native Americans empower themselves through the spirit of solar

*“A frog does not drink up the pond in which it lives”*

--- American Indian Proverb

One of the most beautiful relationships between humans and earth is represented by native American culture. The story of their civilization has been intricately linked to the natural environment, that they worship and that, in which their sustenance was and is still to a large extent dependent. The colonization of their lands by white settlers affected their relationship with nature forever, changing the course of their historical evolution. Today, in modern day United States, the Natives are largely relegated to life in reservations with the exception of few living outside, constituting only 2% of the nation's total population. Poverty at approximately 29.2% as compared to the national average of approximately 15.9% is the highest among all race groups. Inside reservations, there is a paradox of sorts at play in terms of the need for modern socio-economic development and their cultural instinct of preserving the natural environment which they ideally worship, an issue made complex due to the vast amount of non-renewable resources that lie within the reservations. Complex land ownership of such lands, America's insatiable energy needs and developmental aspirations of the natives has brought forward myriads of issues especially the issue of meeting the energy needs of the natives in reservations without compromising their cultural ethics. Many reservations are far from the utility grids, the extension of which proves to be very expensive. Thus, a large number of reservations lack access to reliable supply of electricity impeding not just economic growth but a basic standard of living for the natives.

However, the scene at least relating to meeting the energy needs of the tribes is undergoing a positive change, courtesy micro grids and renewables. The best illustration of this is seen among the Moapa Band of Paiutes tribe who are concentrated in a reservation area in Nevada. A 250 MW hybrid micro grid project was recently (2016) installed in the reservation which is proving beneficial in more ways than one for the members of the tribe. Before the installation of this hybrid plant, their economy was running solely on a gas station, a truck shop and a small casino. These businesses ran on diesel powered generators that was costing the tribe around \$ 1.5



million annually. Combined with this loss of scarce monetary resource was the abject harm to the environment due to the diesel powered generators.

The installation of the micro grid now allows them to tap onto solar power and helps the tribe save around \$ 700,000 annually in fuel costs. There is an expansion of revenue earning for the tribe as a power purchase agreement has been concluded with the Los Angeles Department of Water and Power for delivering clean, solar power to them for the next 25 years. The availability of reliable and clean power now opens up the possibility for expanding productive enterprises by the tribe's members within the reservation. The project has gathered allied economic benefits by ensuring employment for the tribe's members. By leasing land for the installation of solar panels to a private company, a tribal hiring preference program has been concluded. Even in the operation and maintenance stage, work will be sourced to the tribe's residents in the reservation. Most importantly, the micro grid is projected to produce enough clean energy to power approximately 100,000 households, way in excess of the population currently resident in the reservation, aiming to displace 178,000 metric tons of carbon dioxide annually which is equivalent to replacing around 34000 cars off the roads!

This is a story of life coming almost full circle for the Moapas in their reservation. Living without a reliable supply of electricity for a long time was a complicated consequence of the forces of modern expansion which should have ensured that very access in the first place. Today, oscillating between the dichotomy of preserving their unique cultural heritage in which living in close harmony with nature and community living is central, and aspirations for achieving the 21st century notion of development, the Moapas seem to have found a small yet very sustainable solution. The frogs are indeed trying not to drink up the pond in which they live!



Photo sourced from [www.designmattersatartcenter.org](http://www.designmattersatartcenter.org)

# Camels as health workers, courtesy solar arrays in Kenya!

*“Better little than too late”*

--- Cameroonian proverb

In Kenya, remote nomadic tribes have been suffering on more grounds than one. Fostered by the geographical and cultural isolation, health issues, abject poverty and lack of education have become integrated into the lives of these nomadic tribes. In specifically two North Western Kenyan districts, Laikipia and Samburu, (combined population approximately 490,000) due to their extreme geographical remoteness, no mitigation could be offered for a long time for the rampant HIV/AIDS malaise that has been affecting the communities. Entrenched cultural norms together with near absolute illiteracy prevented adoption of family planning leading to large scale health implications such as infant mortality and maternal mortality. The terrain where these districts are located is harsh with a lack of proper infrastructure to connect the communities living there to the nearest urban area with hospitals. Most of the times, emergency health situations took fatal turns due to the inability of the communities in the region to seek fast redress from urban hospitals owing to their isolation.

The Nomadic Communities Trust has been working to ameliorate the lives of isolated nomadic communities through outreach programmes, which culminated in the most creative intervention strategy on collaborating with Designmatters (Design College in the US) in 2007. Recognizing the dire need to provide health services to these communities and mapping the lack of power and accessibility, an ingenious messenger was selected for the task ahead: camels!



The partnership with California based Designmatters and PRISM led to the creation of “Integrated Mobile Health Clinics” which makes use of camels, bicycles, and foot travel to bring door to door service delivery to the nomadic pastoralist tribes of the region. An innovative carriage design to be mounted on camel back was created that comprised a bamboo frame for hauling solar powered refrigerators. The photovoltaic cells used are amorphous silicon, a thin film material on roll-able sheets. The solar panels can also be used for lighting and recharging appliances. The ingenious nature of this innovation lies in many factors. Firstly, the use of camels as the most viable form of service delivery stemmed from the idea that camels can traverse harsh terrains in inhospitable conditions as well as reach remote locations. Secondly, the idea of harnessing the power of the sun to ensure preservation of the medicines for supply created a small revolution in the provision of health services to these communities. Refrigerated medicines mean extended longevity of the same, so even the remotest areas can be ensured supply of medicines.

The villagers now wait anxiously for their “camel mobile clinics”. A simple input of a solar panel atop a mini fridge has ensured that a large number of people affected by the malaise of HIV/AIDS as well as other lethal diseases are no longer relegated to a state of perennial neglect. Till date, due to the solar powered refrigeration of medicines, over 90% of children under age 5 received vaccines in Laikipia and over 5300 women could start using birth control. These mobile, solar powered, camel propelled clinics do not simply provide the medication but also counselling services through the counsellors mounted on them who campaign in a culturally sensitive manner about the need for ending practices like female genital mutilation as well as family planning. The idea of a messenger usually from their own tribe, trained by NGO’s, speaking their language, propelled on a camel, is a non-invasive way to spread awareness on health and education related issues to these isolated communities. The reticence in getting tested for HIV/AIDS has also seen a decrease with a larger number of people turning up for counselling each time a mobile health clinic is in sight.

Yet challenges remain, the main being the availability of consistent funding which is very important since without it, service providers cannot provide lifelong Antiretroviral HIV therapy for patients. If there is a discontinuity, then there is a possibility of ARV resistant strains of HIV emerging in the region. Notwithstanding these limitations, the idea that is represented by the camel propelled mobile health clinics is one of moving forward, in small steps rather than inviting stagnation. To do little is indeed better than doing nothing at all.



Photo credit: Barefoot College

# Solar power illuminating Peruvian heights through solar mamas

*"Yesterday I was clever so I wanted to change the world. Today I am wise, so I am changing myself"*

--- Rumi

An attempt at changing one's own situation did end up changing a lot more in a land far away from where the change was initiated. Five women from Candarave province (population approximately 8600) in Tacna, Peru, travelled to Tilonia village in Rajasthan, India to learn how to maneuver solar technology and bring back the knowledge to their village. Through the agency of the Barefoot college at Tilonia, which has been training rural women from across the globe to become "solar engineers" in their own right, the women from Candarave are now harnessing the power of the sun to install much needed power into their villages.

Lack of electricity posed various challenges for the inhabitants of Candarave province. The province has been very vulnerable to climate changes. Situated at an altitude between 3,500-4,800 meters above sea level, its population is mainly engaged in alpaca and trout breeding. Due to a lack of electricity and consequently complete dependence on kerosene powered generators, this region has seen rapid climate deterioration over the years. The increased greenhouse gas emissions in the region over the years has led to frequent drought and frost situations seriously affecting the food chain of the alpacas. Besides posing problems for the local economy, the CO<sub>2</sub> emissions by the kerosene powered generators have led to health risks especially for the women and children. Children could study in the evenings only under the dim power provided by the generators, that too for the households that could afford them. For most people, evenings meant huddling around kerosene fueled stoves, preparing food for the household as well as the animals they bred and children doing school work under the light of a lamp or a candle. The inhalation of fumes from stoves posed serious health hazards for the community especially the children who began suffering from respiratory problems.



Photo credit: Barefoot College

On being approached by the Barefoot college coordinating team in Peru, a few women from Candarave decided to make a unique journey to the mystical land of India that promised to make 'Solar engineers' out of them. They were joined by women similar to them from not just India but from across the world who were illiterate and without much agency to exert influence due to the debilitating gender biases associated with them. These however, are not unsurpassable blocks for Barefoot college. At Barefoot, an innovative methodology of colours and symbols are used to communicate with women with different linguistic backgrounds and who are illiterate. Barefoot founder Bunker Roy believes that just because someone is illiterate does not mean that she cannot become an engineer or an architect. Braving the initial shock of adapting to an absolutely new culture the Peruvian women gained more than they thought. With the discovery of new friends, culture, language, beliefs, they also discovered the simple innovation that was about to change their lives back home; solar panels. By the end of their six months stay at Barefoot, they learnt how to install solar panels, troubleshoot and also repair them.

On their return, significant changes took place in their province. 'Solar Committees' were set up in each village in the province to disseminate information about the program to provide solar powered electricity to the villages through the efforts of the women 'solar engineers'. 387 solar units were installed that helped provide electricity for 1,362 people. The solar kits were imported from India and based on LED technology that could be simply repaired rather than changed. The impact was immediately felt by the people. Electricity through charged solar bulbs meant that children could study without inhaling smoke in the evenings, the alpacas that were vulnerable to attack by foxes were being better watched and protected, those with trout farms could feed the fish at night, and over all emission from that province was being cut down which in turn helped sustain the natural feeding pattern of the alpacas upon which the economy of the area is dependent. The people in the province began to feel empowered and productive enterprise increased on the whole. Most importantly, a sense of sovereignty was felt by women by breaking barriers and cracking stereotypes. They were venerated not for their domestic roles but for being those, in whose hands lay a solution to the community's major problem, a role traditionally associated with men.

As Barefoot founder Mr. Roy advocates that a solution aimed towards a community must be a bottom up approach that takes the community into confidence. This enables the community to take major decisions regarding their development and they take control of and manage their own affairs. Such is exactly what was seen to happen among the women from Peru whose sincere energies were harnessed to extract the same from the sun, creating a wonderful effect.

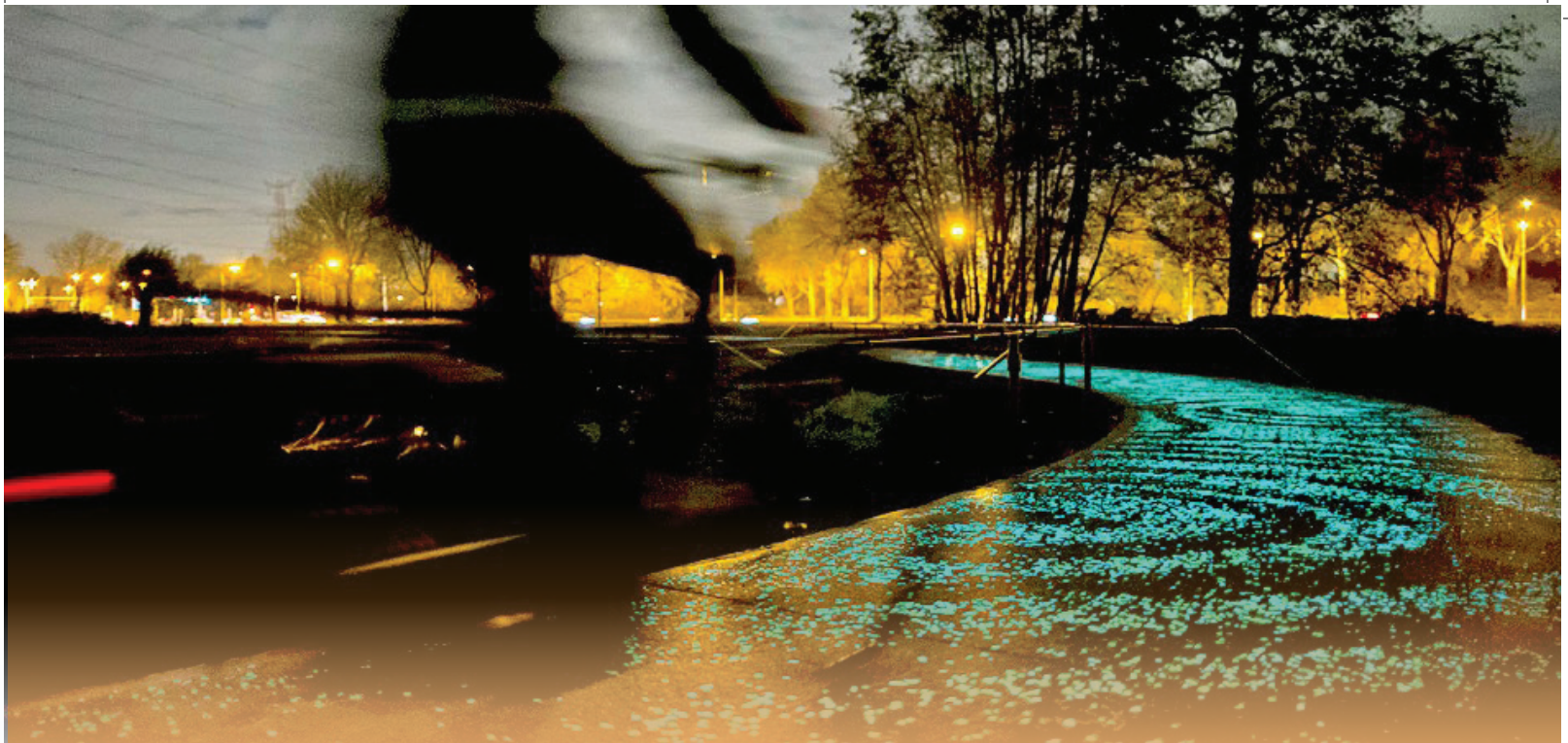


Photo sourced from [www.cnn.com](http://www.cnn.com)

# Solar powered roads: the route to a green future?

*“Everyone here has the sense that right now is one of those moments when we are influencing the future”*

---Steve Jobs

In this era of great innovations and inventions, humankind is exploring all available avenues for growth, especially, sustainable growth. In the energy sector, fascinating ideas for attaining energy security while also protecting the natural environment, are constantly being developed. Cutting edge technological solutions, primarily centred around renewable sources are being implemented worldwide and there has been no slowing down in the search for ways and means to get even more creative and green in the outlook. One such remarkable idea that has been gaining traction is solar powered roads and whether it is the way forward in the future.

This idea of turning roads to a source of clean energy started gaining ground in mid-2000's with a US based couple, Scott and Julie Brusaw, raising funds for experimenting with this new potentially revolutionary idea. The Department of Transport made grants to the couple's company Solar Roadways, subsequent to which construction for first level testing began to acquire momentum. The claims of Solar Roadways were astronomical. The first estimation was that it could produce more than 14,085 billion kilo-watt hours in one year. The targeted load capacity of the panels, 110,000 kg. The roads would keep the temperature above 0 degrees to prevent accumulation of snow. Intended to operate as a smart grid the panels would be having a local positioning system, gather data to intelligently manage traffic and each panel would be lined with LED's to display lane markings and be equipped with load sensors through the data gathering of which, drivers can be warned off about hazards. All in all, a package of true revolution with the vision of changing all the roads of United States into solar roads. The couple raised additional funds through crowd funding that almost crashed the internet and raised around \$2.2 million This nascent idea has been under the harsh glare of sceptics due to the many factors especially those of road safety and costs. Firstly, the idea of replacing all existing roads in the US and replacing it with solar roads has been deemed impossible due to the enormity of the costs involved in doing so. Secondly, whether textured glass surface could provide the traction as is done by asphalt has been



a matter of concern. This controversial idea continues to be supplied with a fair share of criticism on various grounds, high costs of power transport systems required to support the solar roads, exponential power required for the LED's, maintenance of temperature for melting purposes and mainly the inability of a non-inclined surface area to harness the sun's energy like that of roads.

Yet the experiment continues and as has been smartly put by Seth Godin, an American entrepreneur, "the only thing worse than starting something and failing ... is not starting something." The vision to draw power through roads paved the way for experiments on the same, tweaked and made feasible to assess on a smaller scale. Almost 2 years ago, Netherlands laid the world's first solar road which is a 70 meter stretch of cycle path sandwiched between two suburbs. The road has textured, glass covered photovoltaic cells which generates solar power and can support up to 12 tons worth of fire trucks without any damage caused to it. Each of the individual panels are connected to smart meters. The output is then optimized and the electricity that is generated is directly fed into street lighting or the grid. It is designed in a way that if a panel suffers wear and tear, gets covered by dirt or comes under shadow then only that particular PV panel will switch off. SolaRoad which is the group behind the construction of this road have been very optimistic about the future possibilities that have been laid out by this road path. After a few months of installation, the results produced by this solar powered bicycle path were more positive than what was expected. This 70 meter test bike path managed to generate 3000 kWh of electricity which could potentially power a small house hold for a year. The traction provided by the road is impressive which has made it possible to set aside doubts about the solar powered roads for now and explore with more diligence, its feasibility for the future. France is the latest nation to invest faith in this nascent technology by announcing to pave 1000 km of its roads with solar panels with improvisations of its own.

The vision to power our roads through solar technology is probably one amongst the many brilliant ideas that are germinating in the minds of thinkers and innovators to find creative solutions for the afflictions of the 21st century. It is probably only a matter of time before such innovations pave the road ahead. One just has to wait and watch.



Photo credit: GHE

# The illumination of the ancient Phugtal monastery

*“Three things cannot be hidden: the sun, moon and the truth”*

---Buddha

Nestled like a honey comb in caves 2500 years old, Phugtal monastery has been spiritually illuminating the remote Lungnak valley in the Zaskar region since 700 years. The monastery, one of the holiest places in the valley, is a repository of many ancient sacred texts and rich historical traditions with the legendary 16 Arhats (followers of Buddha) believed to be the earliest residents of the cave in which the Phugtal monastery is embedded. Phugtal which means the ‘cave of liberation’ had ironically been repressed by darkness since its very inception, due to a lack of power despite being the seat of inner illumination.

Its intense remoteness further exacerbated by a very difficult terrain to access it, made the extension of grid electricity a near impossible feat. The monastery is inhabited by around 80 monks some of whom are as young as four years. After sun down the absolute darkness that engulfed the monastery posed many problems for its inhabitants. The establishment consists of the main temple, four prayer rooms, residential houses, a small clinic as well as a small library, all of which had to be used under the light of kerosene powered lamps. Education of the monks had been most affected as tradition demands self-study, recital as well as memorization of scriptures for long duration and to have to do that between the designated timing of 8 to 9 pm was very taxing for its inhabitants, under the mercy of Kerosene powered lamps. This in addition to the harmful impact of kerosene use on the general health of the monks especially during the cooking hours where the kitchen aged several hundreds of years revealed a grim, black and sooty image due to the harmful emissions. Even more dangerous was life in general among the monks during the dark where navigating around the monastery premises could cost them their life as it stands atop a very high cliff and accidents sometimes fatal due to absolute darkness were not uncommon. To mitigate these serious issues, the Kargil Renewable Energy Development Authority (KREDA) provided solar home lighting systems but they were insufficient as the monastery has around 70 rooms and not all of them could be covered by these systems.



However, the situation changed dramatically recently when an expedition group that believes in impact tourism called The Global Himalayan Expedition (GHE) decided to undertake the arduous trek of an altitude of 3,800 meters to the Phugtal monastery to help illuminate it. GHE team leader Sonal Asgotraa states “As long standing guardians of ancient wisdom and harbingers of a movement towards enlightenment, it was a strange feeling to see the monks living in darkness themselves.” The expedition brought together 20 people from 13 countries who made this tremendous contribution to help bring light to one of the remotest points in India. Off grid solution through the installation of micro grids sourcing power from the sun was identified as most plausible for powering the monastery. It is also imperative to mention that as the nation moves towards its goal of powering all of its nooks and corners, it is becoming more crucial than ever to do so in ways that are least harmful for the environment. The Himalayan region has suffered its fair share of climate related disasters in the recent past with disasters such as flash floods claiming a lot many lives recently. In fact, the landscape of the Ladakh region is changing remarkably with the fast paced melting of glaciers along with altered weather patterns causing unseasonal rains and increased risk of avalanches. Thus, to be able to resort to a clean source for powering this remote ancient monastery spelled victory for the team responsible, in more than one front.

Today, the monks rejoice, as for the first time their quest for spiritual illumination is being guided by light illuminating the once dark interiors of their holy abode. Light has penetrated even those areas of the monastery which did not even receive natural light before. The oppression of kerosene and coal emissions that dominated life inside the monastery has abruptly ended. The most positive impact is seen on the education front where young monks no longer need to stoop under kerosene lamps to read and recite. Paras Loomba, Founder GHE team states, “The look on the faces of the monks when the monastery was electrified was worth all the months of handwork and the arduous trek.” The GHE team aims to continue powering and thereby empowering remote Himalayan communities. The uplifting experiences such as that of the Phugtal monastery is probably the spiritual fodder that keeps one moving in such directions.



Photo Credit: WWF India

# Solar micro grids changing the human landscape in the exotic Sunderbans

*"If you are in the luckiest one per cent of humanity, you owe it to the rest of humanity to think about the other ninety-nine percent"*

---Warren Buffet

*\*Contributed by WWF India*

Subhankar alias Pintu was at the threshold of adolescence when a solar power station was installed in his village, Rajatjubili, in one of the remotest forest fringe islands of Sunderbans. He is one of the several high school students who made good use of this opportunity. Today Pintu is a 19-year-old young man and extremely busy with his electronic shop and the job of a computer teacher at the local high school where he was a student until recently, earning more than Rs 15000 monthly. He has a diploma in computers and is presently a student of an institute of technical education with a specialisation in electronics.

Stories such as these have become recurring since the installation of the solar power station through the initiative of WWF- India. The Sunderbans, a UNESCO World Heritage site, is a prized natural region with a complex ecosystem encapsulating some of the largest tracts of mangroves in the world. This famous abode of the Royal Bengal Tiger, however has been largely power deficient with many of its islands and villages disconnected from the power grid making lives for the remote communities inhabiting the region debilitated on many fronts.

WWF- India, took the initiative of doing its bit and arrived at decentralized distributed generation powered by renewable sources such as the sun, as the best solution to apply to this unique region. The Rajatjubili solar power station was installed and is operational since 2011. This is probably the only solar micro grid system in India which provides round the clock grid quality electricity to a community living truly on the margins. This project received the Sir William Hudson Award – top honours – at the National Engineering Excellence Awards in Canberra which recognises the most outstanding engineering project and is the highest accolade for a project-based award that Engineers Australia confers.



The project is a network of 60 households and shops with a solar power station of 9.63kWp in the middle. Every household and shop pays a monthly nominal amount of INR 100 to the cooperative society. The day to day operation is managed by a salaried operator. It is owned, operated and managed by a registered cooperative society with a managing committee of 11 members. The consumers as well as representatives of government agencies like West Bengal Green Energy Development Corporation Limited form this energy committee. The consumers are shareholders with 10 shares each. With West Bengal State Cooperative Bank as its banker, today this cooperative society has a corpus of more than INR 3,00,000, an excellent example of the power of small savings by a group of households most of whom are below the poverty line.

Electrification of the village transformed the local market in more ways than one. Services like cell phone charging, photocopying, printing, lamination and refrigeration, once considered out of reach is now available at the doorstep. Hundreds of people from neighbouring villages as well as islands flock to see as well as experience something which is still a technological marvel in this part of Sundarbans where electrification or for that matter access to quality electricity is a distant dream. The project has made it possible for a local high school to operate a computer lab, which again is funded by WWF-India, imparting digital literacy for more than 1200 children – making a generational impact. Modern lighting has also made it possible for children to study till late night and women have more time for themselves after completing household chores.

This project and its impact has given the forest fringe island communities a hope that there is something beyond their current experiences, a way to a brighter future. In the meantime, WWF-India is busy setting up several micro grid projects on Satjelia Island of Sundarbans which will benefit thousands of men, women and children.

Since the inception of this project, Rajatjubili witnessed many new-generation entrepreneurs venturing into uncharted territories previously unknown to most. Most of these entrepreneurs are very successful which is quite remarkable given their humble origins. Pintu's success inspires his juniors at the local high school and makes his parents and other community members proud of his achievements. The story has just begun.



Photo sourced from [www.thehindu.com](http://www.thehindu.com), photo credit: Ritu Raj Kunwar

## Relief efforts aided by solar power in Manipur

*"You have not lived today until you have done something for someone who can never repay you"*

*--- John Bunyan*

*\* In collaboration with Mangaal Sustainable Solutions*

Once called a Jewel of India by Pundit Nehru, the North Eastern state of Manipur has in the recent past been losing this lustre due to the conflicts and discords that has overpowered it. Tensions among the ethnic communities, the existence of the draconian Armed Forces Special Powers Act (AFSPA), incessant agitation demanding the exclusive Inner Line Permit have largely kept the much needed discourse on development away from the centre stage. With an ever increasing need to address the myriads of issues faced by the people of Manipur, individual efforts have emerged to lead the way forward. Mangaal Sustainable solutions is one such entity. Mangaal sustainable solutions has been at the forefront of addressing the energy access issues in Manipur by providing lighting for generating livelihoods, thereby doing its bit in addressing the larger aspirations of the people in the conflict ridden state.

Kabui Khullen, a small village in Tamenglong District in Manipur, was the epicentre of a strong earthquake that occurred in the morning of January 4th, 2016. It was one of the strongest earthquakes felt in the region



in decades measuring 6.7 on the Richter scale. Many households were damaged and casualties were high. The village is about 45 Kms away from the nearest town with poor road accessibility. The intermittent electricity that the village used to get was cut off, which affected mobile communications making the relief efforts very difficult. A team from Mangaal intervened in the situation and in collaboration with a relief agency in Manipur, helped install solar powered mobile charging stations for the villagers that could charge upto 50 mobile phones per day. This largely helped in establishing communication to aid in the relief efforts. Coordination among members from the relief team, communication with relevant sources in the town for acquiring supplies for the victims as well as general organization of the whole relief effort could be stream lined due to the availability of mobile phone connectivity ensured by the solar powered charging stations. This intervention may appear small in the face of the large scale relief efforts that are required in a post disaster scenario but when considering the context i.e remote villages with infinitesimal power, accessibility and resources, the arrival of a station that made available effective communication to aid relief efforts, it leaves a strong impact. In fact, this was not the first time that Mangaal aided in relief efforts through solar power. Chadong Village, in the Ukhrul District of Manipur was submerged underwater when water from the Mapithel dam built on Thoubal river was suddenly blocked. Since the entire village was slowly getting submerged underwater due to the rising water level, the villagers were forced to move to higher grounds in the nearby mountains. A small bridge that used to connect the villages with the mainland was also submerged under water, because of which the villagers had to rely on wooden boats as their only means of transportation as well as essential supplies which took hours to arrive. When Mangaal learned of this problem, they decided that solar powered mobile charging stations could be a solution to their communications related problems as there was an absolute lack of electricity in the new areas that they inhabited rendering mobile connectivity impossible, thereby, creating problems of contact with areas outside. In such a situation, solar powered mobile charging stations enabled the use of mobile phones that served as an important means of communication during emergency, to properly time the arrival and departure of the 2 boats for the villagers, to request for supplies, et al.

Mangaal is currently working in 5 districts of Manipur and wants to expand its business to the remaining districts of the state and hopefully, to other NE states as well. While continuing to offer its existing products and services, it will also focus on various different interventions and innovations where energy access will be directly or indirectly responsible for bettering the lives of the people in Manipur as well as the larger North East.

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# ABOUT IPPAI

IPPAI (Independent Power Producers Association of India) was set up as a not-for-profit association shortly after the Government of India opened the power sector to private industry. Since its inception as an independent body in 1994, IPPAI's aim has been to provide a neutral platform to discuss energy policy and focus on strategic, financial, legal, regulatory and technical issues in the power, oil, gas and allied sectors.

Over the years, we have become a well-informed interactive institution, bringing together important players such as cross-party members of parliaments, government officials and bureaucrats from the power ministries, electricity regulators, financial institutions, independent power developers, international and domestic companies and industry, equipment suppliers, et al.

Our motto 'examine engage empower' has led us to now initiate a strong sense of environmental ethics taking into consideration the need of the hour – to make India energy efficient and secure whilst not compromising on our ecological security.

After numerous IPPAI publications and over 200 national, state-level and international workshops, energy summits, conferences later, we continue to stimulate ideas and innovation for facilitating new and stable business developments, re-strategizing existing models, and promoting healthy competitive growth of the power sector in India.



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