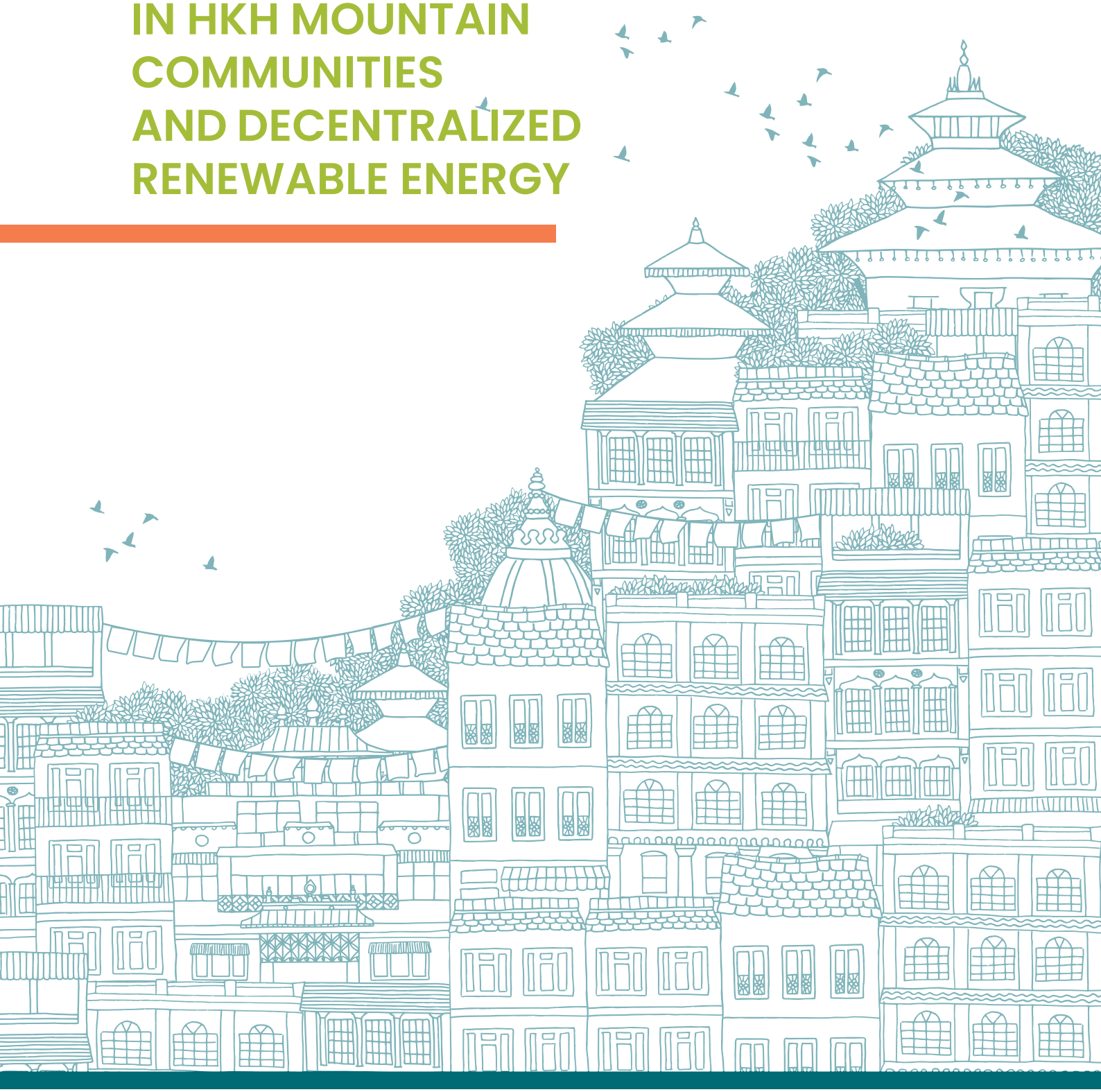
INTERLINKAGES BETWEEN TOURISM IN HKH MOUNTAIN COMMUNITIES AND DECENTRALIZED RENEWABLE ENERGY



SELCO FOUNDATION

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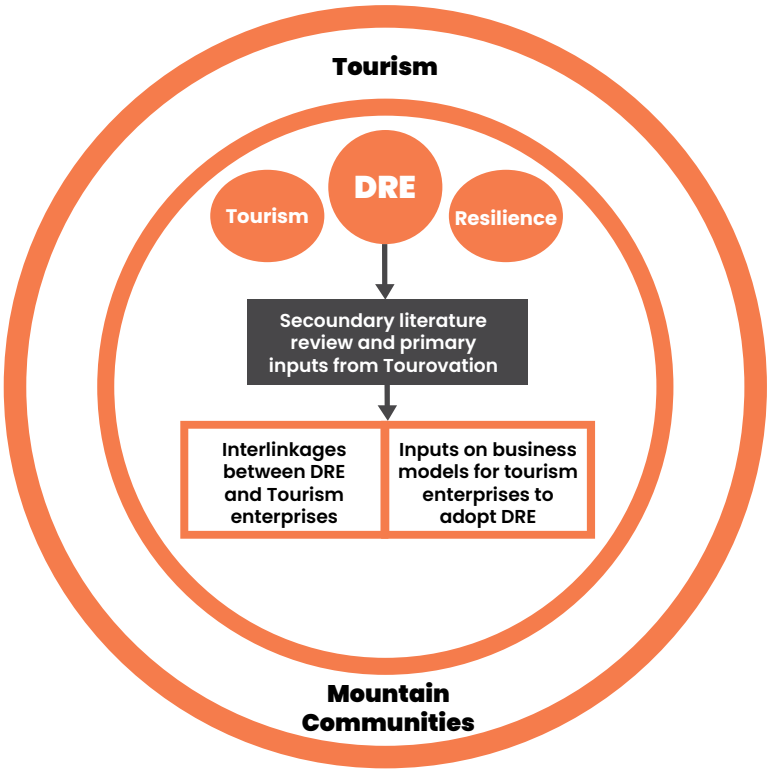
OBJECTIVE

The intent of this document is to provide examples around potential viable business models that integrate distributed energy solutions (DRE) as part of tourism enterprises in ways that they can have a positive influence on building the resilience of their own enterprises and mountain communities to adapt to the effects of climate change in the context of Nepal.

A resilient tourism ecosystem is reliant on several aspects like accessibility, infrastructure, policy legislation, access to energy ,the aspirations and vision of the local stakeholders and the ability of the stakeholders to absorb, adapt and transform to the effects of markets and climate change in the context of Nepal's mountain communities.

In this document we will explore the potential interlinkages between mountain communities, the tourism value chain and the role of distributed renewable energy in the context of Nepal from the perspective of improving tourism propositions, adopting sustainable practices and building resilience.

The report dives into aspects of energy access, energy efficiency and productive use of energy from the perspective of facilities and quality of service in tourism accommodation, food processing and souvenirs that enhance the tourism experience, reduction in emissions and increased infrastructure in communities.



Infographic - Scope of this report

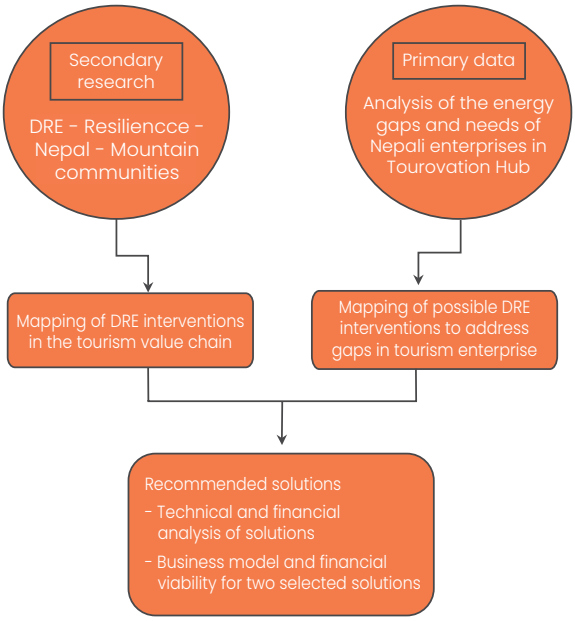
METHODOLOGY

Tourovation Hub Program is an 18-months project titled Building Innovation for Nepal's Tourism Sector by adopting renewable energy and energy efficient business models. Implemented by Nepal Communitaire, with support from ICIMOD and SELCO Foundation to support Nepali tourism entrepreneurs to harness innovative opportunities through ideation, incubation and acceleration of renewable energy (RE) and energy efficient (EE) solutions and approaches. The Tourovation Hub, contributes towards ICIMOD's REEECH (Renewable Energy and Energy Efficiency Capability of the Hindu Kush Himalaya) objective to strengthen the entrepreneurial ecosystem – entrepreneurs, investors, and policy enablers, to integrate RE and EE solutions into small mountain enterprises across the HKH, and scaling up green tourism.

This report has been made with a blend of secondary research and primary consultations with eight Nepali tourism enterprises. The role of the authors has been to combine secondary research with technical and financial inputs for the enterprises enabling them to make decisions on DRE and Energy Efficient (EE) interventions that could add to building their resilience towards shocks.

The consultations, which were participatory in nature happened over a period of 6 months and included more than 40 hours of online consultation with the tourism enterprises, Nepal Communitaire and ICIMOD to go from ideation during a design sprint to a possible working DRE solution customized to each of their businesses. There were also sessions included to bring in the views of experts from Nepal and SELCO Foundation along with a masterclass to introduce DRE based businesses and models to the entrepreneurs.

Due to COVID restrictions the interactions with the Nepali enterprises, experts were through online consultations. The interactions with the stakeholders were facilitated by Nepal Communitaire through one on one online video consultations. SELCO Foundations's expertise revolved around brainstorming with the enterprises about possible DRE solutions to address their needs, providing inputs on the technology and financial modeling. Due to the nature of the gaps identified by the enterprises, it was found that Solar Energy based DRE solutions would be the best fit in most cases.



Infographic - Methodology

INTRODUCTION

Hindu Kush Himalaya (HKH) where the 10 river systems originate through the highest peaks of the world is an important mountain system spread over eight countries of the world, directly supporting livelihoods of about 3% population of the world (Rasul, 2014). The resources that originate from this mountain system support another 17% of the world population living downstream of the region (ICIMOD, 2015). The challenges related to climate change are even more pronounced in a country like Nepal with limited resources, a fragile ecosystem and the capacity to manage diverse and often difficult landscapes. The Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA) defines a hotspot as 'geographical area[s] where a strong climate signal is combined with a large concentration of vulnerable, poor or marginalized people', the HKH region is identified as a "risk hotspot" for climate-induced hazards and disasters (Tucker et al., 2015, Kilroy, 2015, Behrman, 2010).

Mountain livelihoods in the HKH are evolving. The past three decades have seen a significant shift from the agro-pastoral to a combined subsistence-labour system: mountain households no longer rely entirely on their land, though they cannot make do entirely without it. Mountain households increasingly rely on livelihoods that combine farm work with non-farm activities, such as wage labour, circular labour migration, and tourism services (Gioli G. et al. 2019).

These mountainous regions, on one hand are extremely popular tourism destinations while on the other are extremely complex and fragile ecosystems.Tourism intersects with and stimulates a wide range of other sectors in the supply chain, especially agriculture, infrastructure, communications, construction, and handicrafts. Tourism also stimulates a new market for local produce, especially high-value crops. As a complementary livelihood option, the development of tourism will not only generate socioeconomic benefits for the region, but may also address wider social and sociocultural concerns (Kruk 2010) Previous studies have established the role that both tourism and non-tourism enterprises play a tremendous role in the development of tourism activities and contribute to the development of the tourism enterprise and the destination.

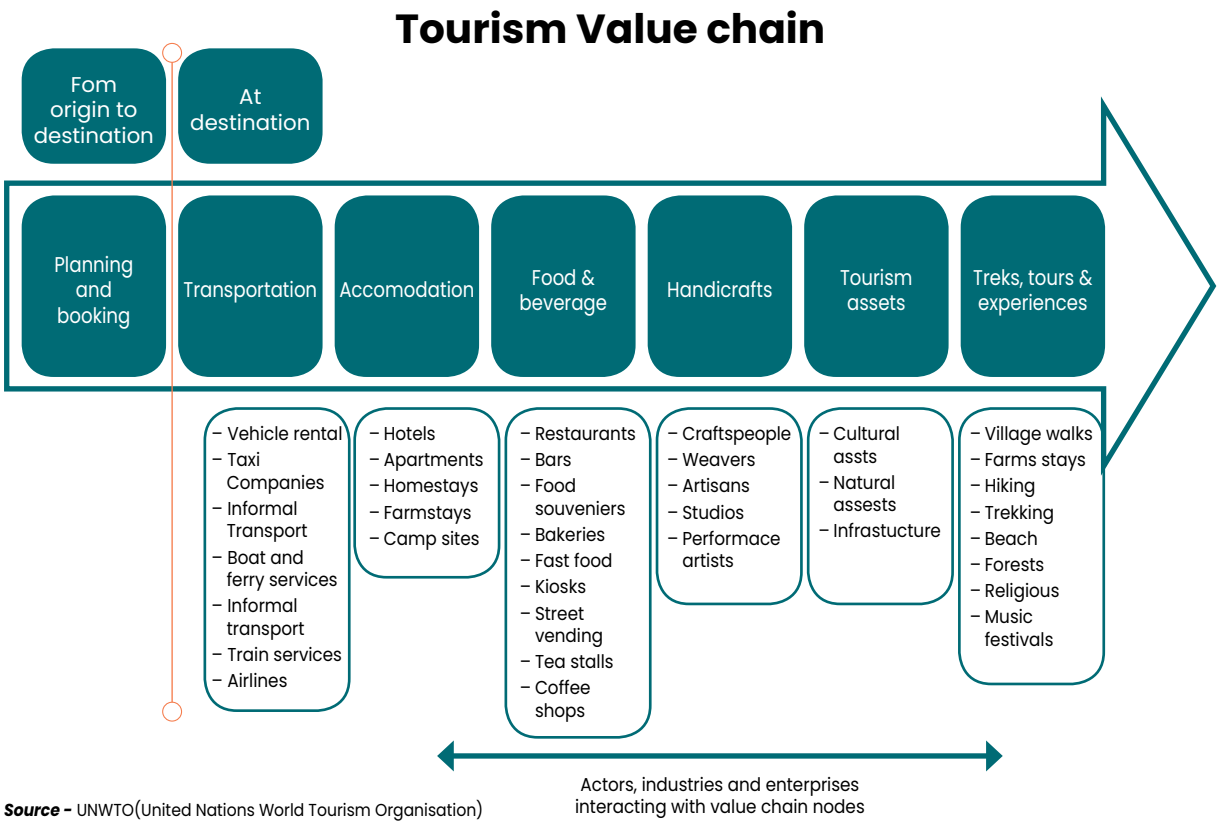
While tourism has the potential to usher in social, economic and environmental development and in many cases forms a majority of the economy due to its multiplier effects mentioned above, it is also associated with increased levels of energy consumption, waste generation and potential disruption to fragile ecosystems. Tourism also contributes to ecosystem degradation through unregulated disposal of solid waste, trampling of soil and vegetation, and locally intensified resource extraction. The infrastructure deemed necessary to sustain tourism also can negatively affect local aesthetic and cultural assets, reducing their value and future tourism income potential (Reinfeld 2003; Zomer and Oli 2011). This makes it imperative for sustainable practices to be adopted in tourism.

Previous studies (Shrestha, Devkota, 2020) have found that all types of livelihoods assets of tourism related enterprises are affected negatively by climate change induced disasters and climate change extremes, some visible impacts being - loss of biodiversity, decrease in local resources, increased disruption in the tourism supply chain. The fragile mountain ecosystem is extremely vulnerable to the effects of a changing climate requiring both the mountain communities and enterprises to continuously adapt practices that can help adapt to or mitigate some of these effects while building the resilience of all involved stakeholders

THE TOURISM VALUE CHAIN

The tourism value chain includes all transactions occurring for tourism services providers – in the source market and at the destination – and the supply of goods and services related to them. It reflects to a large extent the same activities as the 'tourist journey', but looks at those perspectives from a different angle: the angle of tourism services providers.

The tourism ecosystem consists of a diverse set of actors involved in the direct and indirect provision of services and products across different nodes of the value chain. Starting from the tourists arrival to a destination, they interact with actors, enterprises and service providers across nodes like transportation, accommodation, food , beverage, experiences etc.



Source **–** UNWTO(United Nations World Tourism Organisation)

To the left of the red line, the figure illustrates activities that take place in the outbound location . These relate mainly to activities before and after the journey, so during the planning, booking, and sharing phases, as well as the transport to and from the final destination(s). On the right of the line, the diagram shows the activities in the inbound location/destination .

Each of the nodes forms a key backward and forward link to enable the functioning of the ecosystem and it is necessary to look at building aspects of sustainability and resilience into all of them to strengthen the overall value chain.

Node in the tourism value chain	Types of enterprises in each node
Accommodation and hospitality	Camp sites, home stays, hotels, resorts, farm stays, lodges
Transportation	Airline services, taxi services, rental services, train services, boat and ferry services
Food and beverage	Restaurants, cafes, bars,street vendors, bakeries, small scale food processing enterprises
Handicrafts	Weaving enterprises, tailoring and souvenir enterprises, ateliers, potters
Tourism assets in destination	Printing and internet enterprises, drinking water services
Leisure excursions and treks	Trekking and hiking enterprises, tourist guides, City tours enterprises
Outbounding marketing and support services	Websites, booking agencies, travel agencies

INTERLINKAGES DRE AND TOURISM ENTERPRISES

Non-renewable energy systems, such as large-scale plants using fossil fuels like oil, operate under orders from an internal power centre which controls the distribution of the resource it generates. This gives the local stakeholders and consumers no authority in the energy generation process – from the ecological destruction that predates the construction of the plant to fixing prices for final consumption.

Such non-renewable systems are environmentally unsustainable because they are based on the consumption of natural resources. Their expansion results in the faster depletion of environmental treasures and high greenhouse gas emissions that aggravate climate change. Lastly, these systems are also responsible for other pollution-related problems that occur during their production and transportation processes.

On the contrary, renewable and decentralised energy systems, such as small-scale solar and wind energy generation units, are more environmentally sustainable because they use locally available resources. Such models reduce the degree of environmental damage and emit much lower levels of greenhouse gases when used. Localised energy production and distribution is also cost-effective and builds the resilience of the community (Carlo Vezzoli, 2018).

Since its development, decentralised renewable energy has been thought of as a small-time energy generating source, capable of delivering electricity only for home use or at most for basic lighting. Seldom have tried to test the potential of DRE through entrepreneurial use. The scope of creating a service or product, either directly or indirectly from DRE, for creating wealth or assets has been fairly underestimated. (Wheeldon, 2016)

By allowing tourism enterprises to adopt DRE systems, a bridge can be formed between the developmental plans of the Nepal government and their climate-related sustainability goals. A system of operations, powered by decentralised renewable energy, can realise our goal to build resilience amongst such enterprises and provide reliable energy during short-term disasters and longer-term climate changes as well.

In reality, many decentralised renewable technologies have been powering businesses and institutions in the remote areas of the Hindu Kush mountains for several years. The table below looks at some of the interlinkages between the tourism value chain and aspects where DRE can play a role.

Node in the tourism value chain	Types of interlinkage of DRE
Accommodation and hospitality (Camp sites, home stays, basic hotels, rustic luxury, luxury)	Low energy buildings, Solar thermal for water heating,DC water heaters < 75% power consumption,DC floor and bed heating panels,Rain water harvesting,Solar water pump (Pump water, grey water reuse),Clean cooking if LPG not available, biomass for cooking,Basic lighting, TV, fans, mobiles etc,Services - Washing machines, printing, internet
Transportation	Mobility - E-bikes,scooters, Electric vehicles for safaris, sight-seeing etc.
Food and beverage	Food processing - Pickles, jams, jelly, dried fruits, dried meat Cooking solutions for cafes, restaurants,Cooling solutions for shops to sell ice creams, drinks etc. Bakeries
Handicrafts	Bamboo,wood souvenirs, weaving, blacksmits, potters - Mechanisation, Cloth/fabric Souvenirs - Printing and tailoring tote bags, backpacks, flags etc
Tourism assets in destination	Street lights,Water kiosks,Healthcare facilities,Car washing services,Internet, printing and xerox services
Leisure excursions and treks	Charging stations, energy for basecamps and trek, Energy for farm activities,Portable battery packs,On-the-go cooking solutions
Outbounding marketing and support services	Higher ranking and discovery for sustainable/green accommodations,destinations and programs

TOUROVATION HUB

Tourovation Hub Program is an 18-months project titled Building Innovation for Nepal's Tourism Sector by adopting renewable energy and energy efficient business models. Implemented by Nepal Communitaire, with support from ICIMOD and SELCO Foundation to support Nepali tourism entrepreneurs to harness innovative opportunities through ideation, incubation and acceleration of renewable energy (RE) and energy efficient (EE) solutions and approaches. The Tourovation Hub, contributes towards ICIMOD's REEECH (Renewable Energy and Energy Efficiency Capability of the Hindu Kush Himalaya) objective to strengthen the entrepreneurial ecosystem – entrepreneurs, investors, and policy enablers, to integrate RE and EE solutions into small mountain enterprises across the HKH, and scaling up green tourism.

Tourism is one of Nepal's largest industries. However, some of the current challenges for the sector include sustainable innovation, natural resource limitations, climate shocks (extreme weather, natural disasters), environmental degradation, lack of infrastructure for energy access, drinking water supply, road and air transport and publicity amongst others. More recently, the unprecedented nature of the COVID-19 pandemic comes with dire consequences for Nepal's tourism sector. Tourism entrepreneurs and stakeholders estimate that the sector could lose "NPR 40 billion to the crisis, and anticipate job losses for 1.1 million workers".

There is an urgency for Nepali tourism enterprises, particularly micro, small, medium enterprises, to explore innovative solutions and business opportunities in the short and long term that address the above challenges. So that they are able to deliver resilience by designing and developing sustainable value propositions and business models with the ability to absorb, adapt, and transform. In particular, RE and EE innovations that include multi-stakeholder views with business support services is integral for such business model innovation.

As such, with the aim to help Nepali tourism enterprises transform to resilient and sustainable enterprises, the Tourovation Hub aims to promote the adoption of DRE and EE solutions and approaches in tourism enterprises.

ENTERPRISES FROM THE TOUROVATION HUB AND THE IDENTIFIED ENERGY GAPS

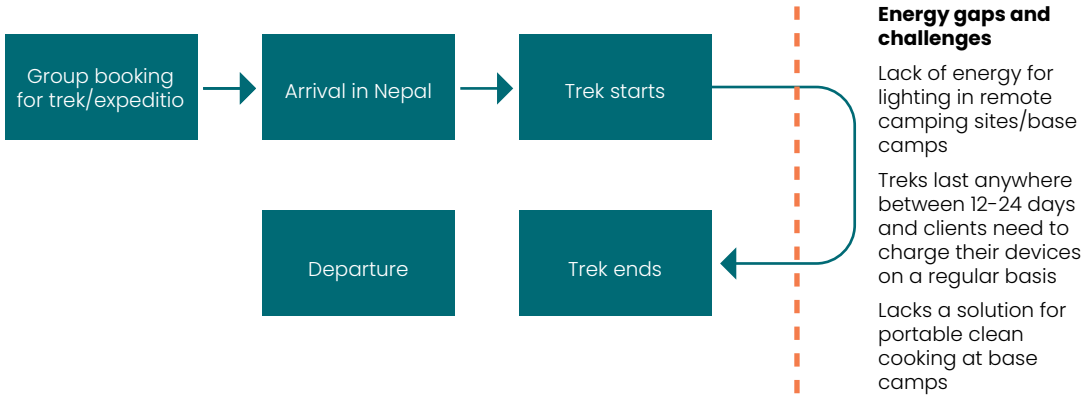
Himalayan Companion

Website - **https://www.himalayancompanion.com/**

About

- Trekking company that specialises in taking groups in the Western Nepali Dolpo region
- Groups usually range from 2 - 12 pax and a crew size of 7 - 20
- Mostly foreign clientele
- Lower and upper Dolpo circuit are the most common
- Head office in Kathmandu, branch office in Dolpo, seasonal hire of staff (7-8 people per group, depending on group), minimum group size 2 guests, requires 1 cook, 2-3 helpers/porters, 1 mule teer/keeper, 5-7 mules, 1 sherpa (cost dependant).
- Revenue streams - Trek package, permits, mountain flights(Commision)

Tourism activities - process flow



Energy gaps and challenges

Lack of energy for lighting in remote camping sites/base camps

Treks last anywhere between 12-24 days and clients need to charge their devices on a regular basis

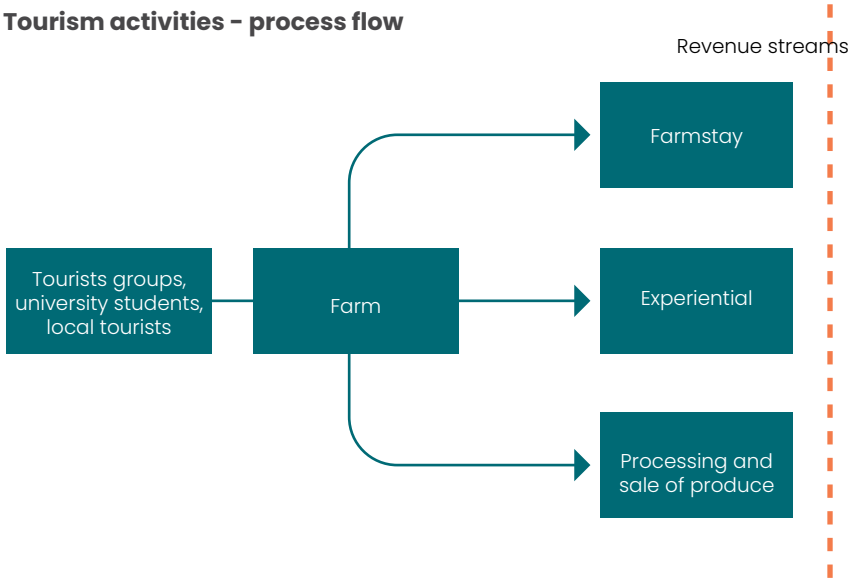
Lacks a solution for portable clean cooking at base camps

Sanskriti Farms and Research Centre

About

- Demonstration farm and homestay running since 2015
- Farm size 14 ropanis (1acre = 7.8 ropanis) 2 RWH pools, 7 rooms(3 bed, 20-25 people) (sustainable , energy efficient building, earth buildings), training hall, fruits and nuts trees , 6000L bio-digester
- Located 50km from Kathmandu at an altitude of 1700m
- Main source of revenue from homestays and training sessions
- 7 room homestays and can host up to 25 people
- On average host, 4-5 big group annually - with 10-15 people for a week long stay
- Small groups of 2-3 people who stay for a couple of days/weekend
- 70% of income from tourism and 30% from training
- Current green practices include - Rainwater harvesting, biogas for cooking, small PV solar and earth buildings
- Impact of COVID-More local travellers and explored market linkage/aggregation for e-commerce
- Revenue streams - Volunteer and student exchange programs, homestay packages, sale of trees, renting venue for events and meetings, training, tours, consulting, technology demonstration, sale of organic produce
- Customer segments - Primary B2C individual tourists, B2B universities etc.

Tourism activities - process flow



Energy gaps and challenges

Frequent power cuts due to which clients can not be provided basic services

Currently has an underpowered solar system not enough for their needs

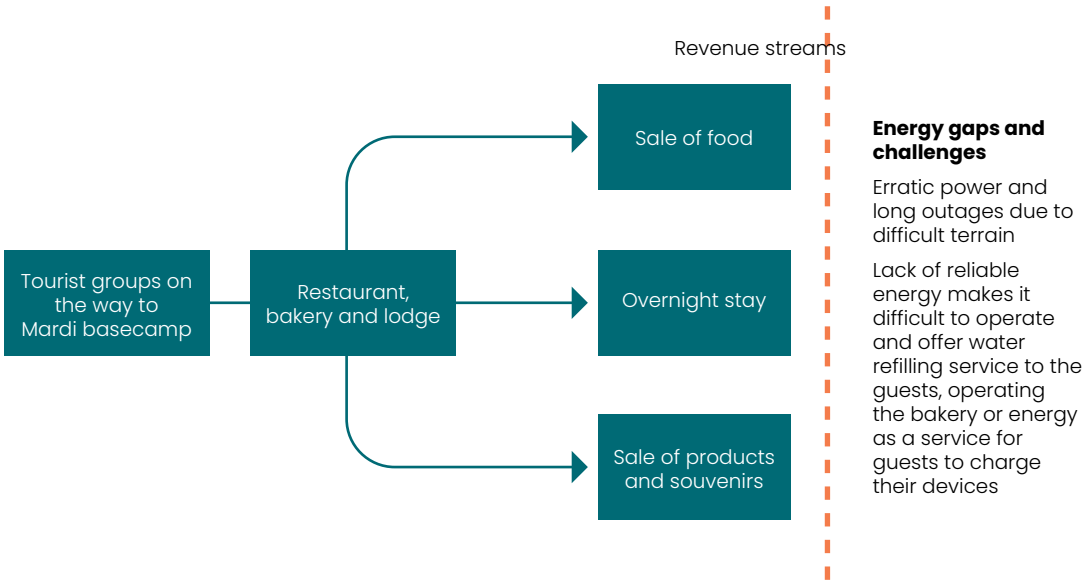
Lack of reliable electricity hampers the potential for food processing

Hotel Trekkers

About

- At an altitude of 3500m, with 8 rooms and a restaurant
- Run by family
- Average of about 200 people visiting per day during season
- People mostly move up from here to Mardi basecamp
- Has bought a machine for bakery setup

Tourism activities - process flow



Energy gaps and challenges

Erratic power and long outages due to difficult terrain

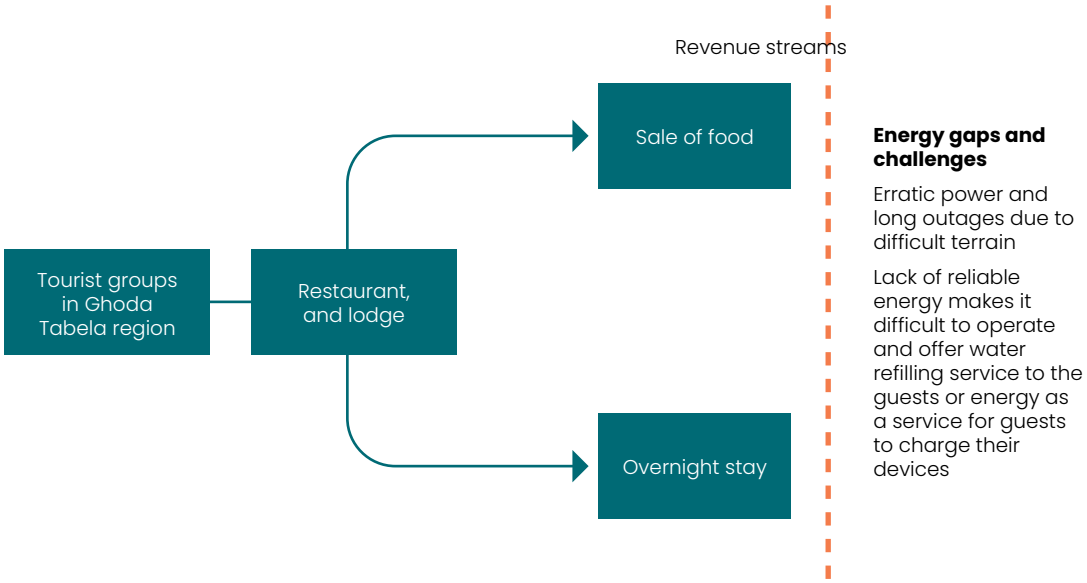
Lack of reliable energy makes it difficult to operate and offer water refilling service to the guests, operating the bakery or energy as a service for guests to charge their devices

Tourism activities - process flow

Tibetan Lodge

About

- Homestay + restaurant with 8 rooms
- In Goda Tabela region
- Most customers are groups on treks and stop for lunch, dinner or stay and to acclimatise
- About 150-200 customers a day during season



Energy gaps and challenges

Erratic power and long outages due to difficult terrain

Lack of reliable energy makes it difficult to operate and offer water refilling service to the guests or energy as a service for guests to charge their devices

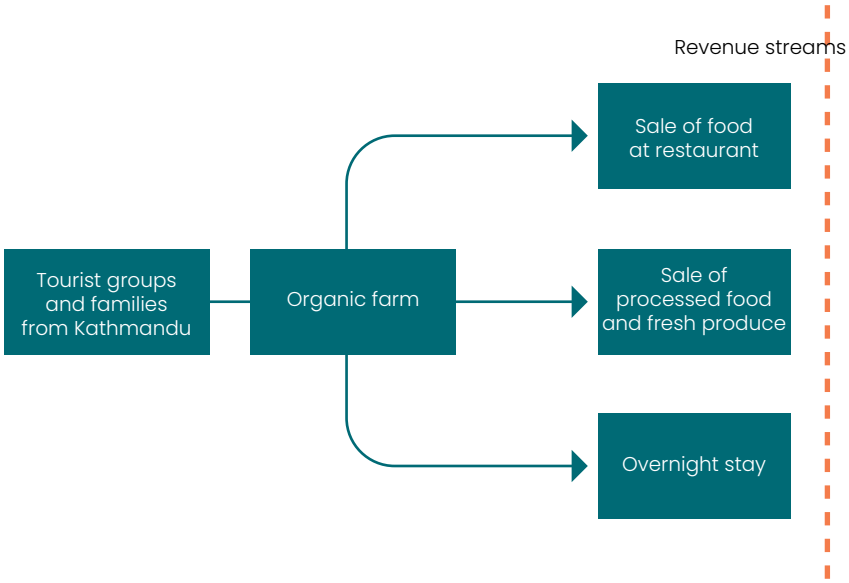
Original Organics

Website - **http://www.originalorganicfarm.com/**

About

- Organic farm very close to urban location in Kathmandu
- Sources of revenue - Homestays, farm produce, diary
- Currently about 50% of revenue is from restaurant, 25% each from homestay and sale of produce
- Impact of COVID - More local tourists
- 10 individual rooms on the farm can accommodate 30-40 people for stay
- About 50 - 60 people at the restaurant
- Customer segments - Corporates, banks, private offices

Tourism activities - process flow



Energy gaps and challenges

Very high costs for LPG, wants to explore bio-gas

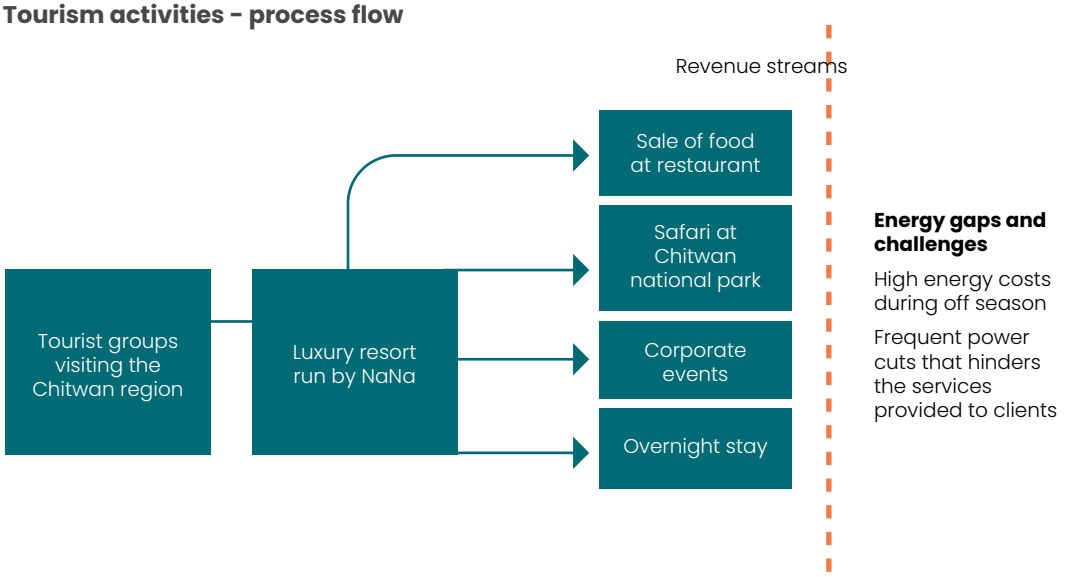
Sees future potential for cold storage as sales of frozen Kimchi form a large part of the business

NaNa Hotels, Chitwan

About

- Luxury resort + property
- Part of a group of 8 companies
- Main high-end clientele mix of foreign and local
- Host many conferences in a year
- Interested to go more environmentally conscious and green

Tourism activities - process flow



Energy gaps and challenges

High energy costs during off season

Frequent power cuts that hinders the services provided to clients

RECOMMENDED/PROPOSED DRE BASED SOLUTIONS

The following DRE based solutions were recommended to the enterprises who were part of the Tourovation Hub based on the needs and gaps identified by them. The solutions preferred by the enterprises were then shortlisted and a technical design and business model recommendation was made for the same based on primary inputs from the enterprises. These recommendations are representative of an ideal scenario for the enterprises post adopting a DRE solution.

1. Portable battery packs (Energy as a service)

Trekking and hiking companies face a challenge of providing services to their clients to change devices, light up tents and toilets while on difficult and long high-altitude treks. Most of the base camps are not accessible all year round and hence do not have access to conventional grid electricity. In such scenarios, lightweight and portable battery packs coupled with lightweight solar panels can be a way to address the energy needs for both the trekking enterprise and the clients. It also allows for energy to be monetised as a service hence it could create a new revenue stream for the trekking enterprise.

Reference - Jackery portable battery generator from daraz.np

Relevance to Tourovation Hub - This particular solution can be applicable to Himalayan Companion and similar trekking organisations in Nepal that lead trek groups to many different remote regions with no access to power on the go. Addition of energy as a service, can create a new stream of income and build a unique proposition for the company. Similar tourism enterprises may be incentivised with relevant technology and financial linkage support to make adoption easier.

Estimated solar design and indicative costs

Component details	Technical specification
Lithium-ion battery station	500Wh portable with AC and DC outputs
Solar panels	100Wp lightweight and flexible PV panels
Approximate cost	NPR 160,000/USD 1342[1]

Energy profile for a typical trekking group data from Himalayan Companion

Load (Group size 10)	Watt used	Rate card/hour/ charge (NPR)	Number required on average for a group	Number of hours used	Energy (wh)	Monetisation per day
Mobile	10	150	10	2	200	3000
Camera	20	250	10	2	400	5000
electric blanket	0	0	0	4	0	0
laptop	60	500	0	2	0	0
light	6	20	20	1	120	400
Mobile/light - team	10	0	10	3	300	0
Satellite phone	15	150	4	1	60	600
GPS	15	150	4	1	60	600
Tab	10	150	10	2	200	3000
Total	**146**				**1340**	**12,600 NPR/105 USD**

[1] 1 USD = 119.20 NPR = 74.40 INR

Business plan/model for IEC/Energy as a service for Himalayan Companion

Year 1		
Initial investment for portable solar system	NPR 480000/ USD 4026[2]	500Wh portable Lithium battery generators with solar panel (Flexible/lightweight)* 3 units
Ownership	Himalayan Companion	
Number of treks in a year	15	Average 15 treks with 10 clients + 10 person team
Number of people per group	10	
Number of days average trek	10	
Monetisation from energy as a service per group	NPR 25200/ USD 211	Up to 3 recharges per group with access to charging every 3 days
Extra mules/porter charge for carrying batteries and panel per group	NPR 10000/ USD 83	
Total revenue per annum	NPR 228,000/ USD 1912	
Estimated profit (target)	-111%	
Profit per annum	-252,000.00	
Year 2		
Initial investment for portable solar system	NPR 158400/ USD 1328	33% depreciation considered due to extreme operation conditions and low performance of batteries at low temperature and high altitude
Ownership	HC	
Number of treks in a year	15	Average 15 treks with 10 clients + 10 person team
Number of people per group	10	
Number of days average trek	10	
Monetisation from energy as a service per group	NPR 31500/ 264	Up to 3 recharges per group with access to charging every 3 days
Extra mules/porter charge for carrying batteries and panel per group	NPR 10000/ USD 83	
Total revenue per annum	NPR 322,500/ USD 2705	
Estimated profit (target)	51%	
Profit per annum	NPR 164,100/ USD 1376	

[2] 1 USD = 119.20 NPR = 74.40 INR

2. Solar fruit and vegetable dryers

For enterprises that run organic farms and farm stays, their clients also are potential customers for processed food products. A solar dryer is a great way to preserve fruits and vegetables which not only increases their shelf life but when packaged forms premium produce that has good market value. Small scale and lightweight solar dryers can be used that can dry up to 30kgs of produce per day.

Reference - Rudra Solar multipurpose dryer

Relevance to Tourovation Hub - This and similar solutions are relevant to organisations like Sanskriti Farms ,Original Organics and similar organisations that work with farm produce and farm stays. It tackles two pressing issues of food preservation and value addition thereby adding value to the business and also creating a diverse income stream. From the experience of both the organisations value addition and processing helped them find local customers during the COVID-19 lockdown and kept business alive, thereby adding a layer of resilience to the businesses.

Estimated solar design and indicative costs

Component details	Technical specification
Dryer	50 KG
Operating Temperature	55 TO 75
Brand	RUDRA SOLAR ENERGY
Air Heating Area	36 FEET
Automation Grade	SEMI AUTO
Color	BLACK
Cover Material	Stainless steel
Approximate cost	INR 6300[3]0 / NPR 100000 / USD 835

[3] 1 USD = 119.20 NPR = 74.40 INR

Assumptions (Based on consultation with Sanskriti Farms and Nepal Communitaire)

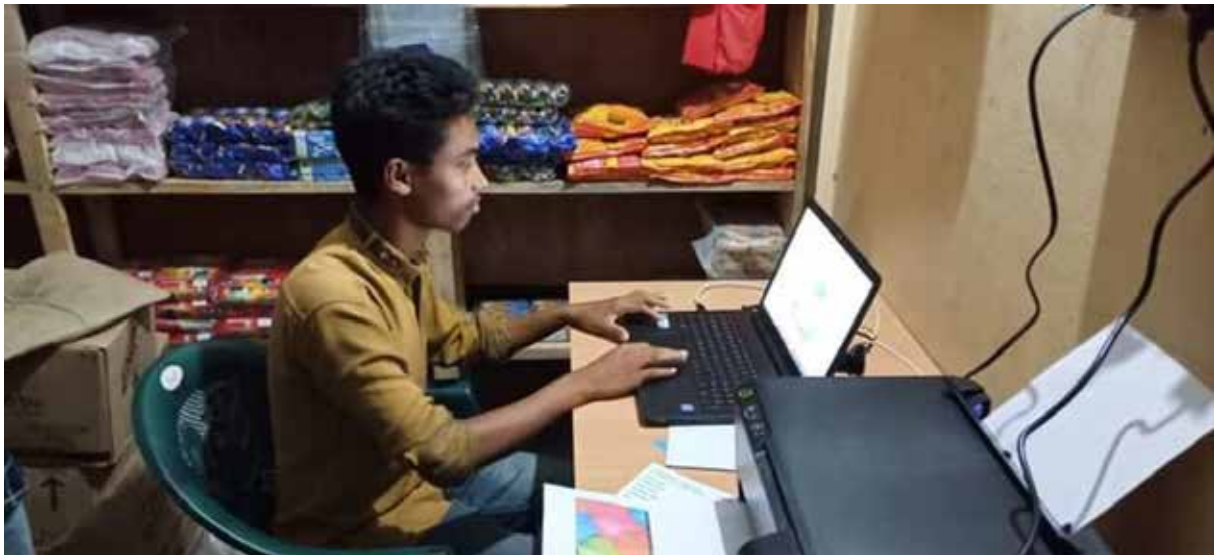
1. It is assumed that the solar dryer will be used during the winters and early summers.
2. The total number of usage for the first year is assumed at 50%
3. It is assumed that the total number of kgs after drying will be at 15 kgs per batch
4. The selling rate for any item is assumed to be Rs. 500 for the first 2 years
5. The input versus the output is assumed to be six times.
6. The maintenance will begin after year 2

Business plan/model for solar dryer with costs in USD

	Year 1 (50%)	Year 2 (75%)	Year 3 (90%)	Year 4 (100%)	Year 5 (100%)
Number of times of usage	30	30	36	45	45
Kgs of output	450	450	540	675	675
Rate of the output	500	500	600	600	750
Table 2	**Income Statement of Solar Dryer**				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Revenue	1,890.00	1,890.00	2,721.60	3,402.00	4,252.50
less cost of goods sold					
Purchase of produce	1,134.00	1,134.00	1,360.80	1,701.00	1,701.00
Gross Profit for Solar Dryer	756.00	756.00	1,360.80	1,701.00	2,551.50
less operational expenses					
HR	504.00	504.00	504.00	504.00	504.00
Maintenance	0.00	0.00	54.43	68.04	85.05
Packets and Stickers	113.40	113.40	136.08	170.10	170.10
Depreciation @ 10%	84.00	75.60	68.04	61.24	55.11
Total operating expenses	701.40	693.00	762.55	803.38	814.26
Gross Income	54.60	63.00	598.25	897.62	1,737.24
ROI	6.50%	7.50%	71.22%	106.86%	206.81%

3. Solar powered internet and printing services

Internet, printing and ticket booking services can be a very good addition to existing tourism enterprises like hotels and lodges or could even work as a standalone nano enterprise. In regions where there is erratic or no electricity, DRE can play the role of an enabler to help start a nano-enterprise that looks at providing these services to tourists.



Reference - A Lok Seva Kendra (Internet, printing and other services) kiosk in North East India

Component details	Technical specification
Solar Module	100Wp X 2
Solar battery	12V, 150AH
Mounting structure	1, 100Wp
Solar inverter	850VA, 12V DC link
Printer	Epson L3100 or similar
Laptop	Basic laptop HP, Lenovo or similar
Consumables	As per site
Approximate cost	INR 115000/ NPR 185500/ USD 1550[4]

[4] 1 USD = 119.20 NPR = 74.40 INR

Assumptions (Based on consultation with similar xerox shop entrepreneur at a tourism destination in Meghalaya)

1. It is assumed that the printing and xerox services are an addition to an existing business
2. The cost of raw material is recorded as INR 1 per sheet
3. Maintenance is accounted at INR 5000 per annum as per the inputs of the entrepreneur

Business plan/model for solar powered internet and xerox services

	Income Statement
Number of print outs per day	15
Number of colour print outs per day	2
Number of xerox copies per day	50
Number of operational days in a year	200
Charge for print out	INR 5
Charge for xerox	INR 2
Charge for colour print outs	INR 10
Revenue	**39,000.00**
less cost of goods sold	
Purchase of paper	8,100.00
Gross Profit for printing and xerox service	30,900.00
less operational expenses	
HR	NA
Maintenance	5000
Cartridge	7000
Depreciation @ 10%	3090
Total operating expenses	15090
Gross Income per year	**15,810.00**

4. Solar powered DC fridge

The availability of a refrigerator improves the shelf life and hence the number of commodities that can be stored or sold in remote tourist destinations. This could enable small business or serve as an addition to existing tourism enterprises in the food and beverages node of the tourism value chain.

Solar DC refrigerators provide a critical add-on to the existing small businesses

Component details	Technical specification
Solar Module	200Wp X 2
Solar battery	12V, 100Ah X 2
Mounting structure	2, 200Wp
Charge controller	20A, 12V DC link
DC Fridge	100L
Consumables	As per site
Approximate cost	INR 115000/ NPR 185500/ USD 1550

5. Solar Home Lighting systems

For tourism lodges, hotels and accommodations, being able to provide access to basic energy during power outages can act as a great value add to the business and increase footfall. This can be addressed using simple solar systems for lighting and mobile charging needs, thus being able to address the basic needs of the clients and travellers. There is also a business opportunity possible to charge clients to use the energy as a service thereby directly monetising the DRE solution.

Reference - System design and costing for Tibetian Lodge by Lotus Energy Pvt Ltd

Component details	Technical specification
Solar Module	100Wp X 2
Solar battery	12V, 80AH * 2
Mounting structure	2, 100Wp
Inverter	900VA Inverter
Lights	7W LED X 20
Consumables	As per site
Approximate cost	**NPR 1,25,000 / USD 1045**[5]

System design and costing for Tibetian Lodge suggested by Selco Foundation

Component details	Technical specification
Solar Module	600Wp X 1
Solar battery	12V, 200AH * 2
Mounting structure	2, 100Wp
Inverter	1.5kVA Inverter
Lights	7W LED X 20
Consumables	As per site
Approximate cost	**INR 1,24,000 / NPR 1,99,000 / USD 1650**

[5] 1 USD = 119.20 NPR = 74.40 INR

6. Solar powered sewing machines

Tourism souvenirs form a percentage of the revenue that is generated at tourism enterprises like restaurants, cafes and lodges. Having access to a solar powered sewing machine can enable setting up a small profit generating entity catering to the tourism market.

Solar-powered DC motors strengthen the local tailoring entrepreneurs by powering the manual sewing machines

Reference - Decentralised solar powered sewing machines in NE India

Component details	Technical specification
Solar Module	300Wp
Solar battery	12V, 200AH
Mounting structure	1, 300Wp
Inverter	600VA/800VA Inverter
Lights	7W LED X 2
Consumables	As per site
Approximate cost	**INR 81,000 / NPR 1,29,000 / USD 1085**

7. Solar powered e-bike charging stations

Load details

Load Type (Eg: TV, Computer)	DC /AC	Power (W)	Nos.	Duration (Hrs.)	Total Watt Hour
E-Bikes	AC	80	10	5.5	4400

Component details	Technical specification
Solar Module	330Wp X 8
Solar battery	12V, 150AH * 8
Mounting structure	8, 330Wp
Inverter	3KVA / 4kVA Inverter
E-bikes	Hero Lectro F6i or similar * 5 with 5 extra batteries
Consumables	As per site
Approximate cost (solar)	INR3,90,000 / NPR 6,25,800 / USD 5215[6]

Business model (Based on assumptions)

Hourly renting	Per half day rent	No of days in a month	No of months	Earnings	Bikes engaged	Revenue	
	INR 400	12	8	INR 38400	5	INR 192000	
Trail/city ride rent	Per trip	number of trips per month	No of months	Earnings	Bikes engaged	Revenue	
	INR 5000	5	8	INR 200000	5	INR 1000000	
						Total revenue	**INR 1192000 / NPR 1903800/ USD 15800**

[6] 1 USD = 119.20 NPR = 74.40 INR

CONCLUSION

The Tourovation Hub is probably the first incubation program that works at the intersection of tourism enterprises, mountain communities and decentralised renewable energy and energy efficiency. The findings of the secondary research and inputs from the enterprises indicate that DRE can play a huge role in adding value streams, additional income and building resilience of tourism enterprises, but it needs to be supported by a robust ecosystem that enables access to finance, technology and capacity building support. The recommendations made in this report identifies some of the possible avenues in this regard but a more indepth field analysis and consultation with varied types of tourism enterprises, development organisations, financial institutions and the government would open up more avenues and unlock opportunities in this regard.

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