



# HYBRID HACK- TEAM 7

MIZORAM, INDIA

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# Abstract

This report proposes the planning of a Hybrid Micro-Hydro and Solar Photovoltaic system for the remote areas of Mizoram, India.

The Indian government has made significant progress in electrifying majority of its villages in the past few years.

The Deen Dayal Upadhyaya Gram Jyoti Yojna and the Saubhagya scheme for rural electrification of villages and households respectively. With reports from the states confirming the electrification of majority of the villages.



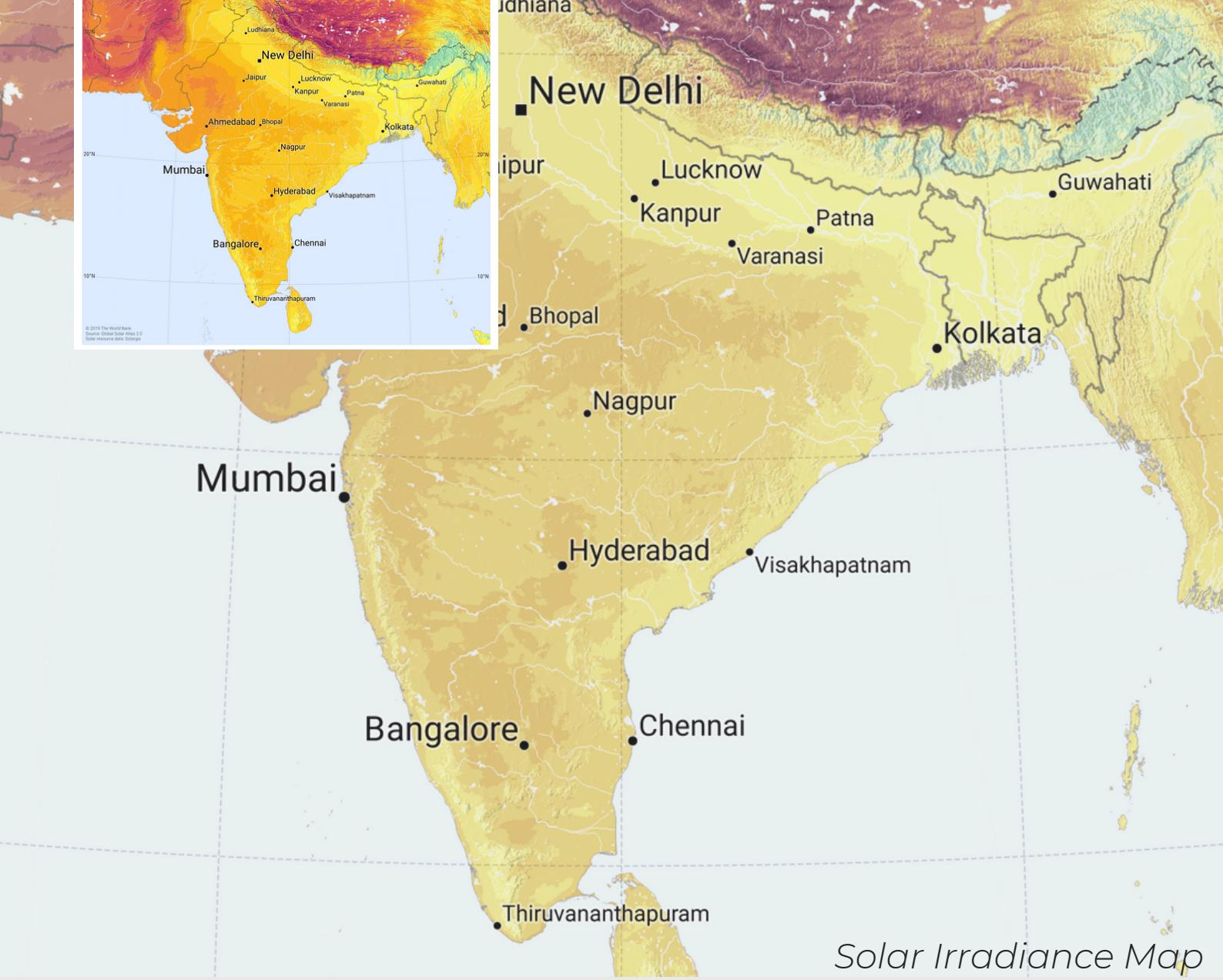
Even after these measures several people continue to live their lives in the dark without access to electricity. An example being a village in Kashmir, Machil which gained access to electricity 74 years after freedom. There are several such villages across the country that face a similar situation today. Some of the predominant areas being in the north eastern villages. Mainly comprising of tribal communities, particularly in Mizoram. We seek to offer a practical implementation of a hybrid renewable energy system to provide them clean, sustainable energy using the natural resources available at hand. To be scaled further in the places with similar requirements and needs.

## Renewable Energy Source

After a comprehensive study of the geographical location and the natural resources available the renewable energy being used are that of a Hybrid Micro-Hydro and Solar Photovoltaic system.

The data we obtained from the analysis of the load profile, utilities of the villages enabled us to create an optimal plan on the basis of capital costs, grid tariff, cost of energy, availability of natural resources and their potential to generate sustainable energy.

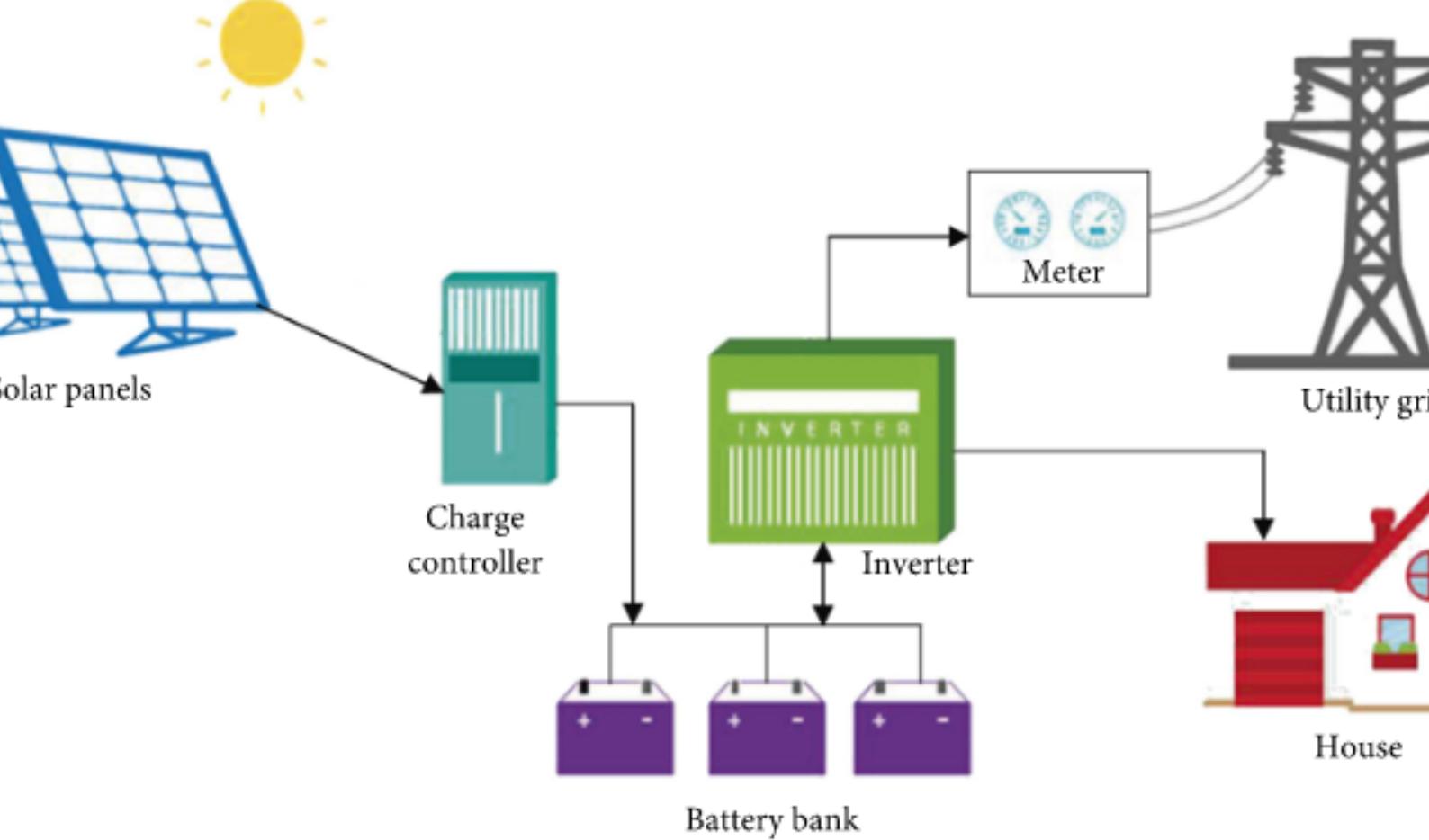




## 1.1 Solar Photovoltaic System

Solar Power in India has been extremely successful with the country's installed capacity reaching 37,730 MW as of August 2020. India has achieved 5th Global Position in Solar power development with a eleven fold increase in the past five years.

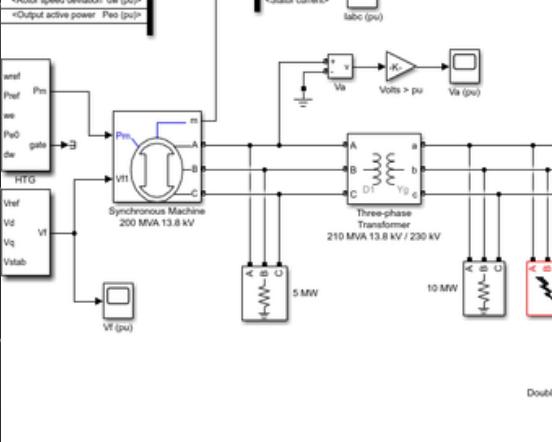
India's combination of abundant sunshine, about 300 days a year and a large population makes it an ideal location for solar energy. The Indian government now aims to reach a capacity of 100GW by the year of 2022.



The above given figure explains the components of a functioning Grid tied system. The DC electricity is stored in a battery bank. [Voltage controller](#), because the [DC voltage](#) generated by the solar cell varies according to the intensity of the sunlight. [Charge controller](#) used to charge the battery bank.

There are different algorithms used to optimize the efficiency of the photovoltaic cells. Such as the [MPPT algorithm](#), [partial swarm optimization](#), [fractional open circuit voltage algorithm](#) and even [Fuzzy logic](#) can be used pertaining to the same.

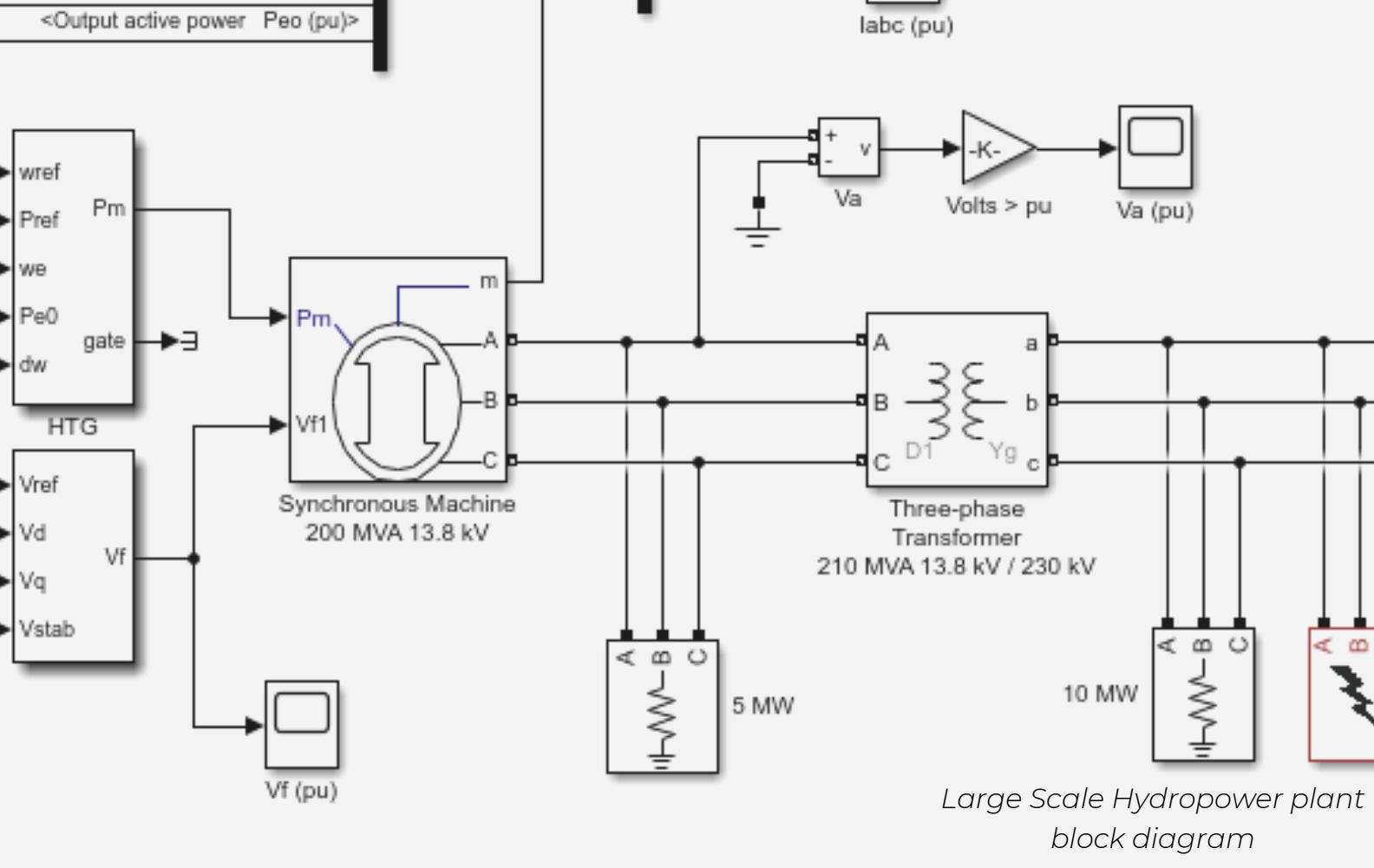
The Battery is then connected to the power inverter to convert the DC voltage to AC voltage according to the applicable voltage system. The [power inverter](#) is equipped with a voltage controller to match the nominal voltage requirements of the system. The output from the inverter can also be used on-grid to the electric power distribution network.



## 1.2 Micro Hydro Power plant

The hydroelectric power plant is a producer of renewable energy that is pollution free and environment friendly. The plant converts the kinetic energy of water to produce mechanical energy in the form of a hydro turbine spin, which is then used to turn a generator to produce electrical energy. Hydropower is the oldest conversion technology in the world.

However there have been several innovations in the field of Micro Hydro Power plants. Such as the [Whirlpool Hydro Power Plant](#) which utilizes the construct of a whirlpool to generate torque with the direction of flow of water that in turn produces the turbine spin.



*Large Scale Hydropower plant  
block diagram*

Micro-Hydropower has a scale power **lower than 100kW**. The flow rate of the stream and the height are certain deciding factors to the quality and the extent of power generation when it comes to electricity generated by the micro-hydropower plant.

Electricity generated from micro-hydro power plants range from **5-100kW** can be used to drive irrigation pumps, agricultural and rural activities which can in turn increase the population, income and ability and expertise of the community.

Another innovation made in the field of micro-hydro power plants are that of **waterotors** which generate substantial electricity from streams with flow rates as low as **2mph**. These have made hydropower much economical and effective to broader water sources.

# Geographic Study



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## **Study of energy resources available and status of Electricity**

**Villages under study:** Sugarbasora & New Adam, Diblibagh Sub, Lunglei District, Mizoram - 796751

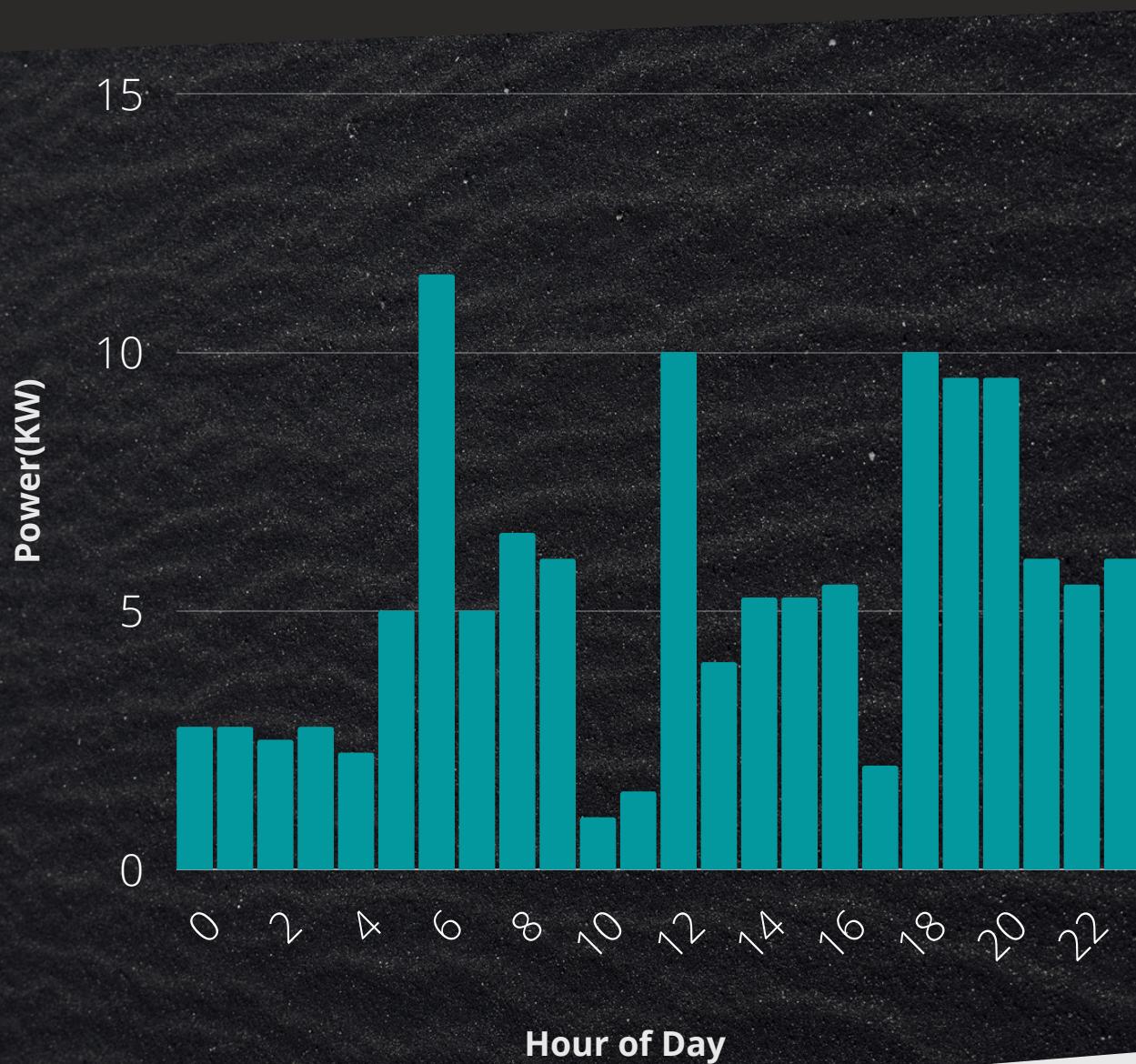
A stream of the river Karnaphuli/ Khawthlangtuipui flows in between these two villages.

Sugarbasora, Diblibagh has scarce availability of power while New Adam is yet to receive electricity.

## 2.1 Regional and Geographical Analysis.



## 2.2 Area research



Population of Sugarbasora: 440  
Number of Households: 84  
Population of New Adam: 150\*  
Number of Households: 36\*

**The utilites and the calculated collective load profile for the Villages Sugarbasora and New Adam.**

# 3

## Physiochemical Analysis

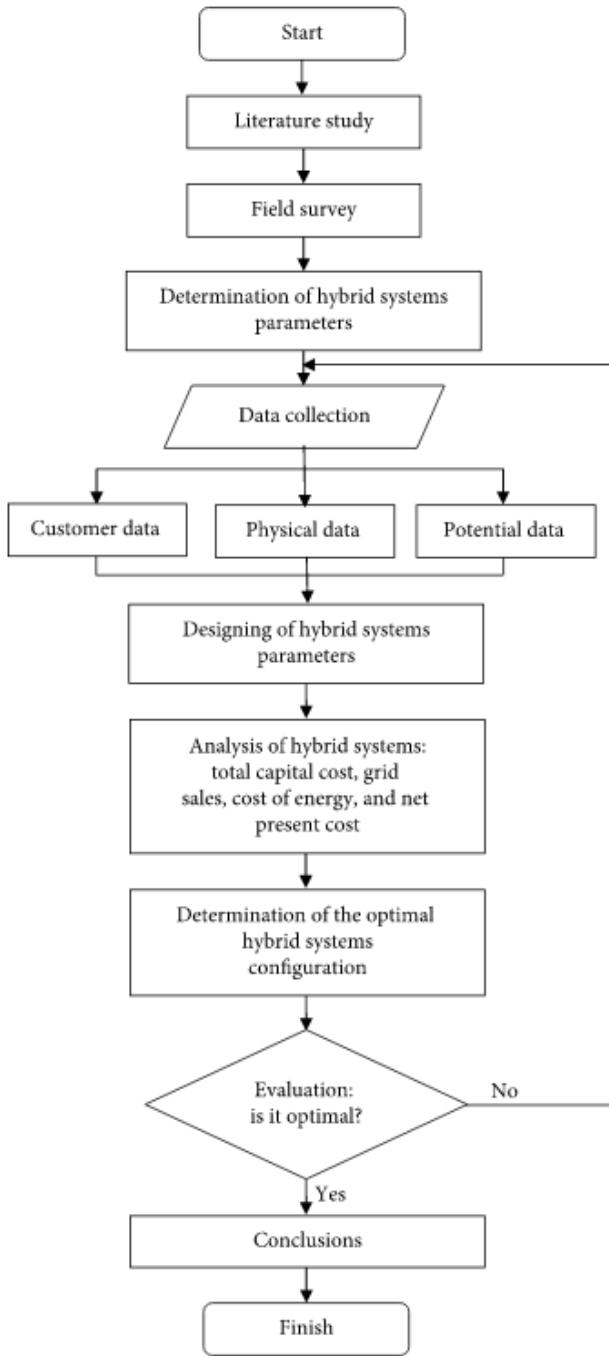


The two villages share the river beds of [Karnaphuli/ Khawthlangtuipui](#). The use of solar photovoltaic cells have been done in the nearby villages in one or two spots allowing us to observe their performance to implement the same in the villages of Sugarbasora and New Adam. The [tropic of cancer](#) runs through Mizoram providing the area with abundant sunlight, warm winters and hot summers. Out of the heavily forested areas nearby these villages have much higher levels of solar irradiance.

### [Physiochemical Analysis of river Karnaphuli/Khawthlangtuipui:](#)

The comprehensive study cited in this project gives us an elaborate perspective on the different water qualities of the river. The water quality is indicated to be poor however the [high flow rate](#) of the river and the height of the channels passing through the villages make it an ideal source for us to utilize. The corrosive nature of the water can be tackled by the use of galvanised turbines in the micro hydro-power system.

# Project Description



Above given is the procedure of this study followed. The location of the project was selected after the analysis of **population margins** without access to electricity. The majority of them lying in the African subcontinent. ( South Sudan, Chad, Democratic Republic of Congo and Liberia to name a few)

However, India has a massive population that sometimes leads to lapses in the availability of resources. Leading to millions of people in India living their lives in the dark without access to electricity even after reports of complete electrification of households. It is to these **livelihoods** that our project caters too.

This project has been planned considering the potential to make a significant reach while keeping in mind the rational factors of the system and several causes of concern.

## **4.1**

### **Our Motivation**

The north east of India is an extremely culturally diverse state comprising of several ST communities. [Mizoram](#) having one of the largest community populations. The mountains, rivers, forests of North East are nothing short of Heaven on earth. The lives of people living in these states however is quite the contrary. North eastern villages and states have incredible potential when it comes to expanding the huge tourism sector of India and in terms of human resources. Given the right opportunities and provisional requirements they could be an incredible asset to development of our entire nation.

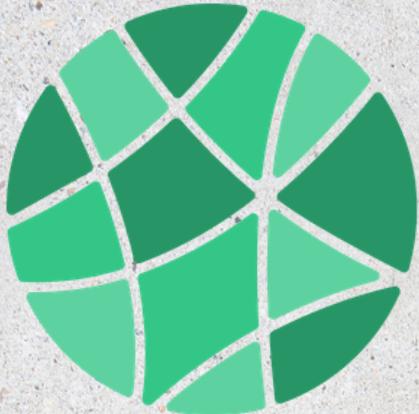


## **4.2 Methodology**

The planning of the project occurs in stages. Upon the literature study and field surveys the hybrid parameters are determined. The data collection of the load profiles and the electricity requirements are listed. Accordingly the designing of hybrid parameters and hybrid system are planned. The Analysis of hybrid systems, total capital costs and other economical aspects are considered. The Optimal hybrid systems configuration is simulated and evaluated using HOMER GRID. The conclusions are then made on the basis of the results obtained.

## 5.

### Software Used

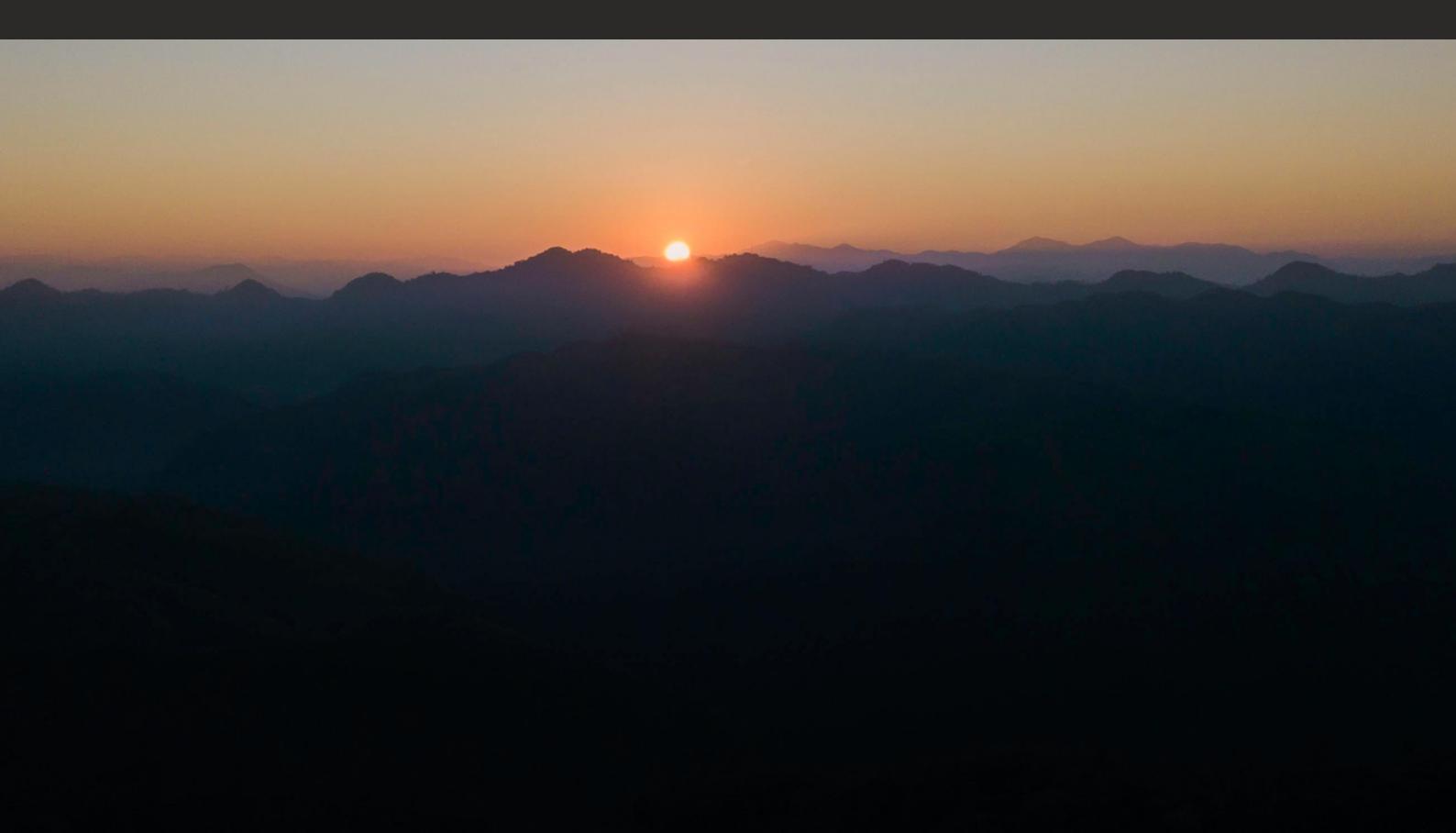


Hybrid Optimization of Multiple Energy Resources is a software to optimize the reduction of **demand charges** and analyzing the net, present, total costs, grid sales upon model analysis of the hybrid renewable energy system and Energy Arbitrage.

Matlab and SIMULINK used to model the diagrams of the hydro power plant system's turbine.

## 6.

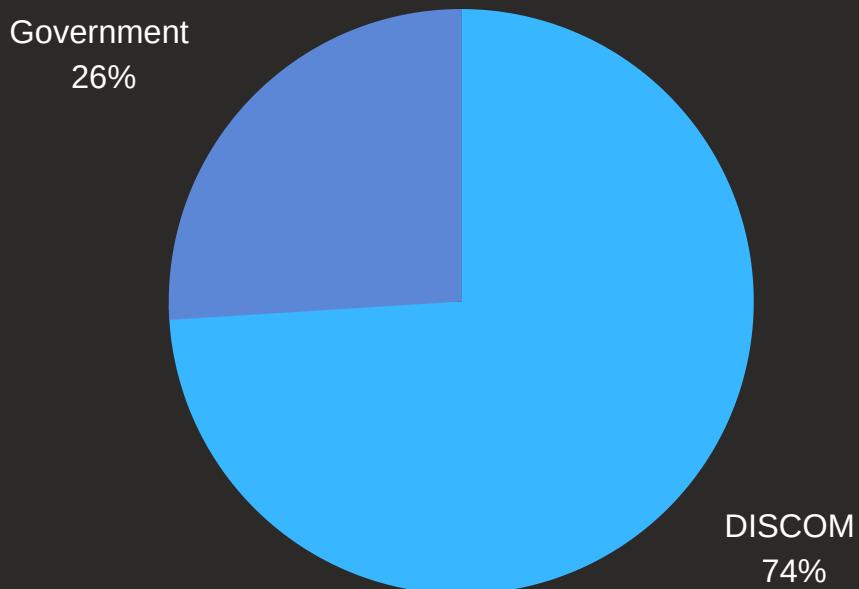
# Merits, Demerits & Applications



- + This project improves the quality of life for about thousand people residing in Sugarbasora and New Adam. Having access to electricity enables them to have better infrastructure for healthcare facilities, educational institutions and households.
- + This project is scalable to other such villages around Mizoram and other north eastern states where the geographical factors are similar.
- + **Cost effective:** The estimated cost of setting PV system is 20 lakh for the villages collectively.
- The river being corrosive in nature with its chemical composition might require regular maintenance of the micro-hydro power plant.
- . The main source of income and produce for the residents of Sugarbasora and New Adam is farming. The electricity generated by the micro-hydro power plant can be used for irrigation and other rural farming activities.

## **Additional Note: Release of Bidding Document**

# **Privatisation of Power Distribution**



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The government of India Power ministry issues privatization of power distribution activities across nation for both states as well as union territories. With the drop of DISCOMs, this is a crucial step taken by the government.

Understanding how this affects the system:

The **positive** being in all the urban areas is that government expects private sector to own 100% of electricity distribution operations and in mixed rural areas, it expects 74%. This also brings along a lot of changes in the complexity of power distribution. Mainly with a grid tied hybrid system there are positives with this venture and the project plan.



## References:

[1]

The demographics and the status of the situation in the respective villages have been testified by the resident and our reference for this project. Credits to [Mr.Kirabaran Chakma](#). We thank him and are extremely grateful for his contribution.

[2]

Md. Ripaj Uddin, Md. Moazzem Hossain, Shakila Akter, Muhammad Edris Ali & Md. Aminul Ahsan (2020) Assessment of some physicochemical parameters and determining the corrosive characteristics of the Karnaphuli estuarine water, Chittagong, Bangladesh, Water Science, 34:1, 164-180, DOI: 10.1080/11104929.2020.1803662

View at:

<https://www.tandfonline.com/doi/full/10.1080/11104929.2020.1803662>

[3]

Sugarbasora Population - Lunglei, Mizoram. View at:  
[census2011.co.in/data/village/271463-sugarbasora-mizoram.html](https://census2011.co.in/data/village/271463-sugarbasora-mizoram.html)

[4]

Ramadoni Syahputra, Indah Soesanti, "Planning of Hybrid Micro-Hydro and Solar Photovoltaic Systems for Rural Areas of Central Java, Indonesia", Journal of Electrical and Computer Engineering, vol. 2020, Article ID 5972342, 16 pages, 2020. <https://doi.org/10.1155/2020/5972342>

View at: <https://www.hindawi.com/journals/jece/2020/5972342/#copyright>

[5]

View at: <https://www.ijert.org/research/electricity-demand-evaluation-for-rural-electrification-IJERTV4IS060726.pdf>

[6]

View at: <https://www.wikivillage.in/pincode/diplibagh-kawizau-pincode-796751/>

[7]

View at: [https://www.researchgate.net/figure/MATLAB-simulink-model-of-the-grid-integrated-hydro-and-solar-based-hybrid-systems\\_fig3\\_258397113](https://www.researchgate.net/figure/MATLAB-simulink-model-of-the-grid-integrated-hydro-and-solar-based-hybrid-systems_fig3_258397113)



# THANK YOU!

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