GRADO EN INGENIERÍA EN TECNOLOGÍAS INDUSTRIALES

TRABAJO FIN DE GRADO

Financial statement analysis for making under the main grid Mini-grid viable

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Madrid

Declaro, bajo mi responsabilidad, que el Proyecto presentado con el título

Financial levers for making under the main grid Mini-grid viable en la ETS de Ingeniería - ICAI de la Universidad Pontificia Comillas en el

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Análisis de los estados financieros para hacer viable la minirred bajo la red principal.

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Entidad Colaboradora: ICAI - Universidad Pontificia Comillas)

Palabras clave: Minirredes, India, Desarrollo rural, Sostenibilidad, Redes no interconectadas, Energías renovables, Acceso a la electricidad, Modelos de negocio

En este proyecto se ha desarrollado un modelo financiero variable y replicable para analizar las palancas identificadas que intervienen en la supervivencia de las minirredes y se han explorado diferentes mecanismos para estimar la viabilidad futura de una colaboración público-privada, obteniendo resultados alentadores especialmente para los casos con generación local junto a la red principal.

Introducción

India tiene una de las economías de más rápido crecimiento del mundo y una demografía que cambia rápidamente. La población total de la India en 2019 rondaba los 1.366 millones de habitantes. Con este influjo de personas, el consumo de electricidad de la India, así como su industrialización, se están desarrollando rápidamente.

El acceso a una energía fiable y accesible es vital para el desarrollo económico y la mejora de la calidad de vida de las personas. En la India, un segmento considerable de la población sigue careciendo de acceso al servicio eléctrico, sobre todo en las regiones rurales. Según la Agencia Internacional de la Energía (AIE), unos 200 millones de personas carecen de acceso a la electricidad y muchos más sufren cortes de suministro periódicos. Para satisfacer la creciente demanda de energía de la India, el gobierno se ha fijado el objetivo de proporcionar acceso universal a la energía para 2025. Esto incluye aumentar la capacidad de generación de electricidad, ampliar las redes de transmisión y distribución y fomentar el uso de fuentes de energía renovables [1]–[3]

En este contexto de desarrollo, el Gobierno ha puesto en marcha varios planes e iniciativas, como el Deen Dayal Upadhyaya Gram Jyoti Yojana y el plan Saubhagya, para mejorar el acceso a la electricidad en las zonas rurales.

Las minirredes son redes de generación y distribución de electricidad a pequeña escala que abastecen principalmente a pueblos o zonas con poca demanda de electricidad. La electricidad producida se distribuye a los consumidores dentro del área de la minirred a través de una red de hilos y cables. Las minirredes se consideran un instrumento fundamental para aumentar el acceso rural a la electricidad y cumplir los objetivos de acceso universal a la energía. Son una opción de bajo coste para extender la red nacional a lugares periféricos, y pueden instalarse de forma rápida y sencilla. Las minirredes, que pueden configurarse para utilizar fuentes de energía renovables, también pueden ayudar a reducir las emisiones de gases de efecto invernadero y aumentar la seguridad energética [4].

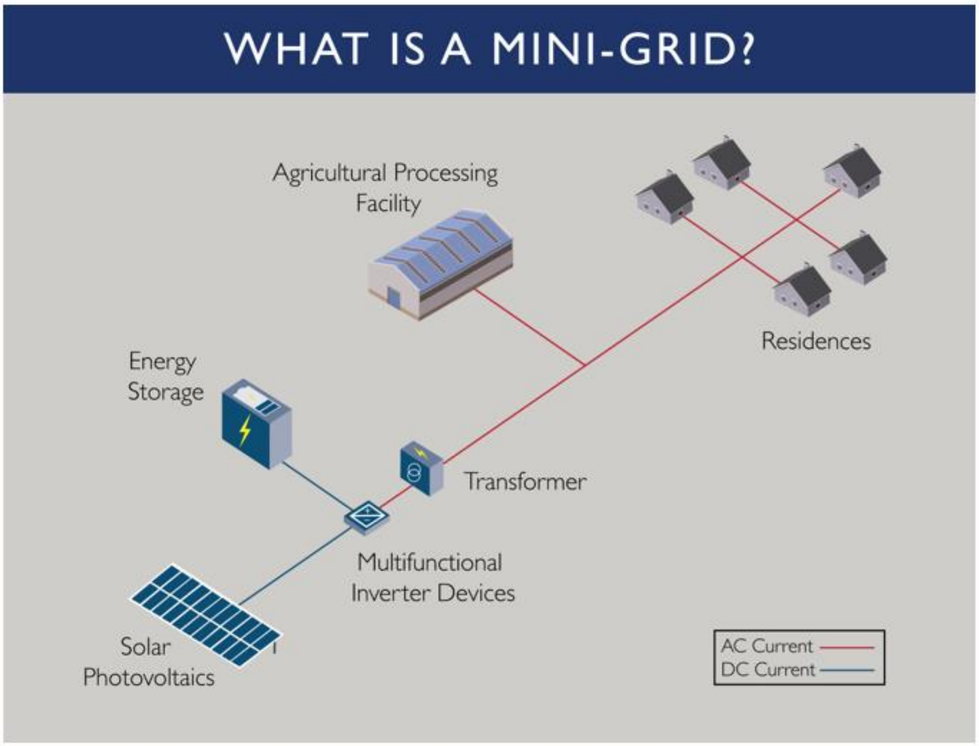

Figure 1 Minigrid

Definición del proyecto

India tiene una importante población rural, que representa alrededor del 65% de la población total. Según el Banco Mundial, se calcula que 893 millones de personas viven en regiones rurales. La población rural india se dedica sobre todo a la agricultura y sus profesiones asociadas, y suele carecer de acceso a instalaciones y servicios esenciales como la electricidad [6] [7]. A pesar de los esfuerzos, sigue habiendo obstáculos considerables para mejorar la vida de los habitantes de las zonas rurales de la India.

El proyecto se basa en una iniciativa de The Tata Group para probar la rentabilidad del desarrollo de minirredes en la India. Así, a lo largo del trabajo se presentarán y analizarán los resultados del modelo estudiado para optimizar y permitir extraer conclusiones sobre la viabilidad económica de diferentes palancas y sensibilidades para poder suministrar energía fiable a través de las minirredes a las zonas rurales de la India con un beneficio. [8]

Este proyecto desarrollará un modelo financiero sencillo y reproducible para identificar las posibilidades financieras y analizar las palancas financieras que hacen asequible el modelo. Los tipos de palancas más importantes se enumeran en el capítulo 2 "Palancas financieras y deducción fiscal". A lo largo de este documento se explicarán las palancas para permitir la configuración de un informe preciso.

Descripción del modelo

El proyecto se basa, en primer lugar, en un estudio exhaustivo de la situación actual de las minirredes, sus posibles variaciones y adaptabilidad. En segundo lugar, se creará un modelo automático para estudiar un amplio abanico de escenarios futuros, en adelante denominados casos, analizando las variaciones de existir diferentes costes de financiación.

Tras una contextualización del estado del arte de las minirredes, se ha procedido a analizar una situación de consumo eléctrico, ante un crecimiento de la demanda variable y diferentes sensibilidades como penalizaciones por la falta de fiabilidad de una minirred previamente obtenidas a partir de un sistema de modelización algebraica general.

Los resultados del programa de optimización nos han dado el inventario óptimo para una situación de partida establecida, este inventario se introducirá en el modelo de cálculo desarrollado para el proyecto. El modelo estudia automáticamente el valor actual neto en distintos casos y los costes de financiación.

El análisis de los estados financieros se llevó a cabo examinando los datos financieros, realizando un análisis de ratios y efectuando un análisis de sensibilidad basado en diversos escenarios. El análisis utilizó datos reales cuando se disponía de ellos y estimaciones sensatas cuando no.

El análisis de los estados financieros se basa en la información obtenida a partir de simulaciones realizadas mediante un modelo de optimización lineal codificado en GAMS (sistema general de modelización algebraica). Como ejemplo del modelo se han determinado seis tipos de financiación y ocho casos diferentes, lo que da un total de 48 soluciones para analizar. Sin embargo, la fuerza del modelo radica en que al ser todo automático, permitirá estudiar cualquier caso independientemente no sólo del coste de financiación sino también del flujo de caja, la moneda, los impuestos de sociedades, la depreciación, la necesidad o posibilidad de repartir dividendos o los costes del proyecto.

Resultados

Tabla 1 Corolario de resultados Valor actual neto

NPV (Millones de euro)		Type of case							
		1	2	3	4	1A	2A	3A	4A
Type of Leverage	1	1,8091	1,6653	8,7393	9,2389	1,8091	1,8907	8,6723	9,2180
	2	1,5621	1,4279	7,7169	8,1635	1,5621	1,5694	7,6569	8,1422
	3	1,0636	0,9481	5,6976	6,0418	1,0636	1,0636	5,6512	6,0204
	4	1,3446	1,2186	6,8280	7,2290	1,3446	1,3617	6,7740	7,2076
	5	1,2454	1,1232	6,4265	6,8072	1,2454	1,2543	6,3752	6,7857
	6	0,8262	0,7192	4,7610	5,0591	0,8262	0,8620	4,7208	5,0379

1	Non-refundable financing
2	Non-profit and non-interest bearing financing
3	Fixed-rate financing
4	Financing through crowdfunding
5	Financing through green bonds
6	Financing through social venture capital

1	Existing Main Grid (Base Case - Do nothing)
2	Improve Main Grid (for improved reliability)
3	Local generation only (disconnect the main grid)
4	Existing Main Grid + Local generation (for improved reliability)
1A	Enforced reliability target + Do nothing
2A	Enforced reliability target + Improve Main Grid
3A	Enforced reliability target + Local generation
4A	Enforced reliability target + Local generation + Improve Main Grid

Conclusiones

Sobre la base del análisis exhaustivo de los estados financieros, puede concluirse que el proyecto de minirredes en la India presenta unos resultados financieros sólidos y tiene potencial para seguir expandiéndose. Sin embargo, el bajo poder adquisitivo de las zonas rurales y el bajo precio y consumo de energía en comparación con los elevados costes de implantación de las minirredes dificultan la realización del proyecto si no se consigue el apalancamiento adecuado. Habrá que seguir vigilando la situación para detectar posibles cambios que permitan una planificación estratégica viable a largo plazo.

Los efectos medioambientales y sociales del proyecto también pueden repercutir en su rentabilidad. La central puede encontrar oposición u obstáculos normativos si tiene un efecto perjudicial sobre el medio ambiente o las comunidades vecinas. El coste de la electricidad desempeña un papel importante a la hora de determinar su rentabilidad. Podría ser difícil obtener fondos suficientes para cubrir los gastos de funcionamiento de la red si los precios de la energía son bajos. Alternativamente, si los costes de la energía son más altos, la rentabilidad de la central podría aumentar, pero es importante tener en cuenta también el peligro de la reducción de la demanda, la creciente competencia y la volatilidad de los precios.

Las partes interesadas pueden utilizar las perspectivas para alinear sus estrategias y acciones con los objetivos financieros del proyecto y contribuir al desarrollo sostenible del sector de las minirredes en la India. La competitividad de una central eléctrica puede verse muy afectada por las políticas y normativas gubernamentales. Por ejemplo, las subvenciones y los incentivos a las energías renovables pueden reducir el coste de producir electricidad a partir de fuentes renovables. Además, la posibilidad de que las ayudas financieras supranacionales -como las del Banco Mundial- influyan de manera pertinente en los precios de financiación.

Financial statement analysis for making under the grid mini grid viable.

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Key words: Mini grid, India, Rural development, Sustainability, non-interconnected grids, Renewable energy, Access to electricity, Business models

This project has developed a variable and replicable financial model to analyse the identified levers that intervene in the survivability of minigrids and have explored different mechanisms for estimated the future viability of a public-private collaboration, obtaining results that are encouraging particularly for the cases with local generation alongside the main grid.

Introduction

India has one of the world's fastest-growing economies and a rapidly changing demographic. India's overall population in 2019 was around 1.366 billion. With this influx of people, India's electricity consumption as well as industrialization is consequently rapidly developing.

Accessibility to dependable, accessible energy is vital for economic development and enhancing people's quality of life. In India, a sizable segment of the population still appears to lack access to electricity service, particularly in rural regions. According to the International Energy Agency (IEA), around 200 million people in India lack access to electricity, and many more face regular power shortages. To accommodate India's increasing demand for power, the government has established the objective of providing universal access to energy by 2025. This includes boosting capacity for electricity generation, extending transmission and distribution networks, and encouraging the use of renewable energy sources [1]– [2]

In this context of development, the government has launched various schemes and initiatives, such as the Deen Dayal Upadhyaya Gram Jyoti Yojana and the Saubhagya scheme, to improve access to electricity in rural areas.

Mini-grids are small-scale power generation and distribution networks that primarily serve villages or areas with little demand for electricity. The produced electricity is distributed to consumers within the mini-service grid's area via a network of wires and cables. Mini-grids are viewed as a critical instrument for increasing rural access to power and meeting universal energy access goals. They are a low-cost option for extending the national grid to outlying places, and they can be installed fast and simply. Mini-grids, which may be configured to utilize renewable energy sources, can also help to cut greenhouse gas emissions, and increase energy security. [3]

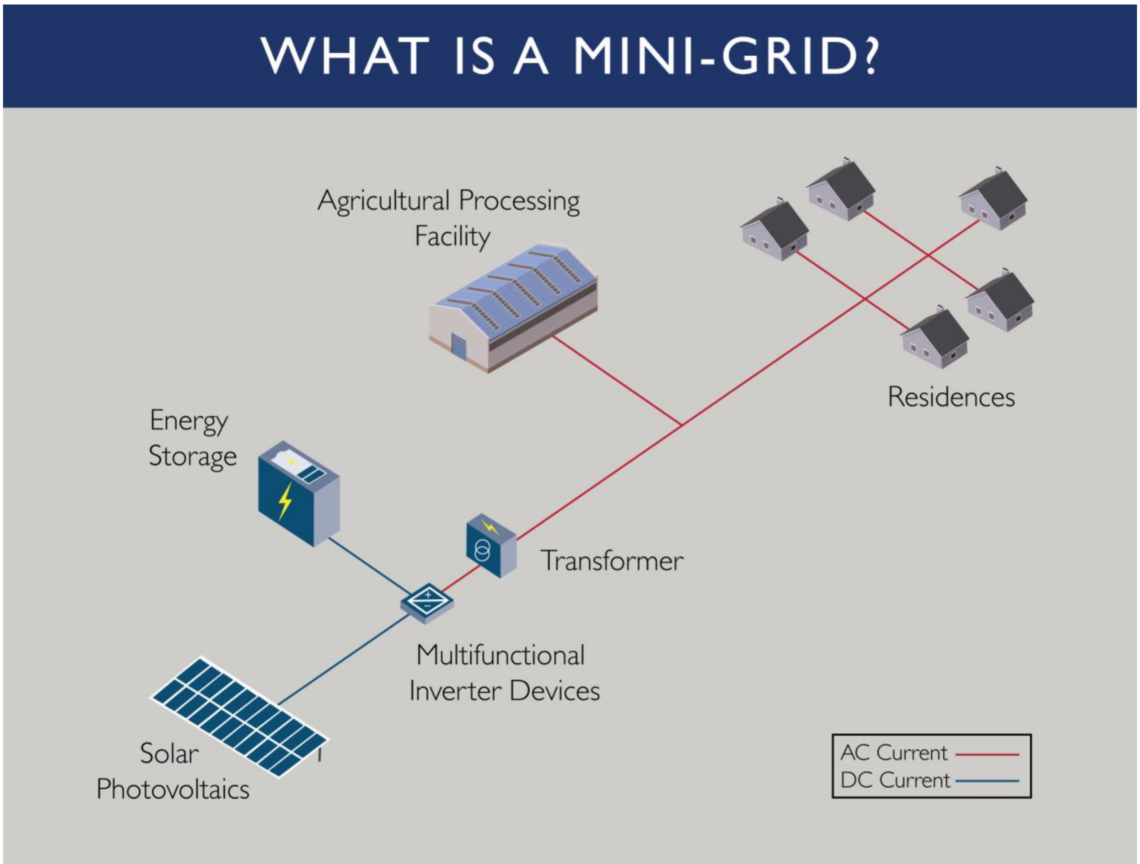

Figure 1 Minigrid

Project definition

India has a substantial rural population, accounting for around 65% of the overall population. According to the World Bank, with estimated 893 million people living in rural regions. India's rural population is mostly involved in agriculture and its associated professions, and they commonly lack access to essential facilities and services such as electricity. [4] [5] Notwithstanding the efforts, considerable obstacles to improving the lives of rural residents in India remain.

The project builds on a Tata initiative to test the cost-effectiveness of mini-grid development in India. Thus, along the paper will be presented and analyse the outcomes of the model studied to optimize and allow for conclusions on the viability of different paths, levers, or sensitivities to supply reliable energy through the mini grids to the rural areas of India. [6]

This project will develop a simple and replicable financial model to identify financial possibilities and analyze the financial levers that make the model affordable. The most important types of levers are listed on *chapter 2 "Financial levers and tax deduction"*. Along this paper the levers will be explained to allow the configuration of a precise report.

Model description

The project is based firstly on an exhaustive study of the nowadays situation of mini-grids, their possible variations and adaptability. Secondly, an automatic model will be created to study a wide range of future scenarios, hereafter referred to as cases, using different financing costs.

After a contextualisation of the state of the art of mini-grids, we have proceeded to analyse a situation of electricity consumption, faced with a growth in variable demand and different sensitivities such as penalties for the unreliability of a mini-grid previously obtained from a general algebraic modelling system.

The results of the optimisation programme have given us the most optimal inventory for an established starting situation, this inventory will be introduced in the calculation model developed for the project. The model automatically studies the net present value in different cases and the financing costs.

The financial statement analysis was conducted by examining financial data, conducting ratio analysis, and performing sensitivity analysis based on various scenarios. The analysis utilized real data when available and sensible estimations when not.

The financial statement analysis is based on information obtained from simulations carried out by a linear optimization model coded in GAMS (general algebraic modeling system). Six types of financing and eight different cases have been determined as an example of the model, giving a total of 48 solutions to be analysed. However, the strength of the model lies in the fact that being all automatic, it will allow to study any case independently not only of the financing cost but also of the cash flow, the currency, the corporate taxes, the depreciation, the need, or possibility to deliver dividends or the costs of the project.

Results

The net present value (NPV) analysis is used to determine the feasibility of various projects or initiatives inside a corporation. If the NPV is positive, the project is likely to create positive net cash inflows.

Table 2 Results corollary of Net present value

NPV (Millions €)		Type of case							
		1	**2**	**3**	**4**	**1A**	**2A**	**3A**	**4A**
Type of Leverage	1	1,8091	1,6653	8,7393	9,2389	1,8091	1,8907	8,6723	9,2180
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Conclusions

Based on the comprehensive financial statement analysis, it can be concluded that the mini-grid project in India exhibits sound financial performance and holds potential for further expansion. However, the low purchasing power in rural areas, and the low price and low power consumption compared to the high costs of implementing mini-grids, make the project difficult to realise if the appropriate leverage is not achieved. The situation should continue to be monitored for possible changes that allow for a successful long-term viable strategic planning.

The project's environmental and social effects may also have an impact on its profitability. The plant can encounter opposition or regulatory obstacles if it has a detrimental effect on the environment or neighboring communities. The cost of electricity plays a significant role in determining how profitable it is. It could be difficult to make enough funds to cover the grid running expenses if energy prices are low. Alternatively, if power costs are higher, the plant's profitability could rise, but it is important to consider the danger of reduced demand, growing competition, and price volatility as well.

Stakeholders can utilize the insights to align their strategies and actions with the project's financial goals and contribute to the sustainable development of the mini-grid sector in India. An electric plant's competitiveness can be significantly impacted by governmental policies and regulations. For instance, subsidies and incentives for renewable energy can lower the cost of producing power from renewable sources. Furthermore, the possibility that supranational financial support—like that from the World Bank—could impact financing prices in a pertinent manner.

Index

I. CONTEXT OF THE STATE OF PLAY FOR RURAL INDIA'S MINIGRIDS

A. INTRODUCTION

A.1 MINIGRIDS

Mini grids, often call microgrids or isolated grids, are local energy production and distribution networks that can operate disconnected from the main electricity grid (stand-alone operation) or prevent power outages by covering microgrid customers' peak demand while connected to the main grid. [7]

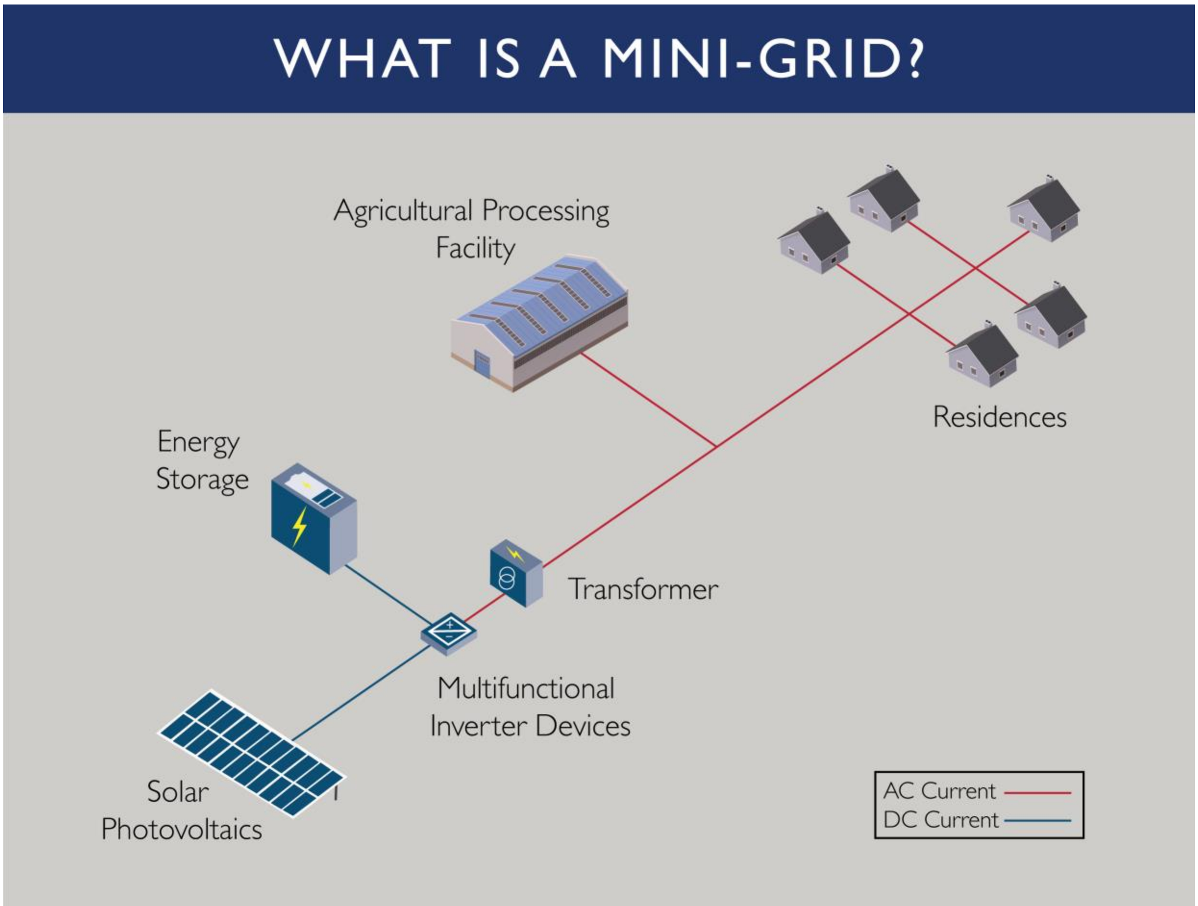

Figure 2Minigrid

They usually consist of a set of nearby buildings (homes and offices, a hospital, and a factory…) that are powered by distributed renewable energy, solar or wind, or diesel backup generators, often combined with energy storage, typically via batteries.

Minigrids as a solution for rural isolated areas have a brief history dating back to the 1990s, when they originally emerged as a potential option for giving energy access to isolated and rural towns that were not linked to the national grid.

With the expanding acknowledgment of the importance of electricity access in accomplishing the Millennium Development Goals (MDGs) and later Sustainable Development Goals (SDGs), the usage of mini grids gained traction in the early 2000s (SDGs). Mini grids, have progressed significantly over the last two decades, from simple diesel generator systems to more sophisticated hybrid systems that combine renewable energy sources such as solar, wind, and hydro power. [8]

A variety of reasons have contributed to this, including technological advancements, the lowering cost of renewable energy, and increased awareness regarding the severe environmental and health consequences of fossil fuels.

Mini-grids are now seen as an important component of the worldwide drive to attain universal energy access by 2030, particularly in poor nations where the expense of expanding the national grid is too expensive. According to the International Energy Agency (IEA), mini-grids may deliver energy to over 450 million people by 2030, reducing CO2 emissions by up to 1 billion metric tons per year. [9] [10]

A.2 MOTIVATION OF THE PROJECT

The present project "Financial levers for making under the main grid minigrids viable" will address the issue of energy access daily faced by billions of people over the world. This project aims to display the cost of the project and aims to deem if a realistic and cost-effective solution through minigrids is reachable, even if the community where the mini grid settles is suffering from energy access, energy poverty or both.

> Energy access is the 7th Sustainable Development Goal, and according to the IEA: "Achieving full access by 2030 will require connecting almost 100 million people every year, but the world is not on track to reach this goal. Projects like the present will contribute to facilitate the access to energy of million homes."

Mini grids are small-scale power generation and distribution networks that primarily serve villages or areas with little demand for electricity. These systems, which can be either AC or DC, produced electricity to be distributed to consumers within the mini-service grid's area via a network of wires and cables.

Mini grids can be configured to service a variety of clients, ranging from families to small companies, to larger commercial users. They may power a wide range of appliances and equipment, not only lights, fans, or refrigerators, but also agricultural, small-scale industrial, and other revenue-generating operations.

Mini grids are viewed as a critical instrument for increasing rural access to power and meeting universal energy access goals. They are a low-cost option for extending the national grid to outlying places, and they can be installed fast and simply. Mini grids, which may be configured to utilize renewable energy sources, can also help to cut greenhouse gas emissions, and increase energy security.

For developing countries, minigrids are a potential answer to the supply to isolated regions problem. Minigrids could greatly contribute to the provision of access to modern energy services anywhere the national grid is commonly undersized or non-existent. By leveraging dispersed generation and renewable energy sources to reduce greenhouse gas emissions and boost energy security, minigrids can aid in local economic growth. [9]

Enhancing the capabilities of minigrids has been a focus in recent years. The incorporation of energy storage technologies, such as batteries, is a crucial area of development since it may increase the stability and dependability of the system and enable the use of additional renewable energy sources. Utilizing smart grid technology, such as improved metering, demand response, and real-time monitoring, can assist to optimize minigrids. Operation and guarantee that it is providing energy services efficiently and sustainably. This is another area

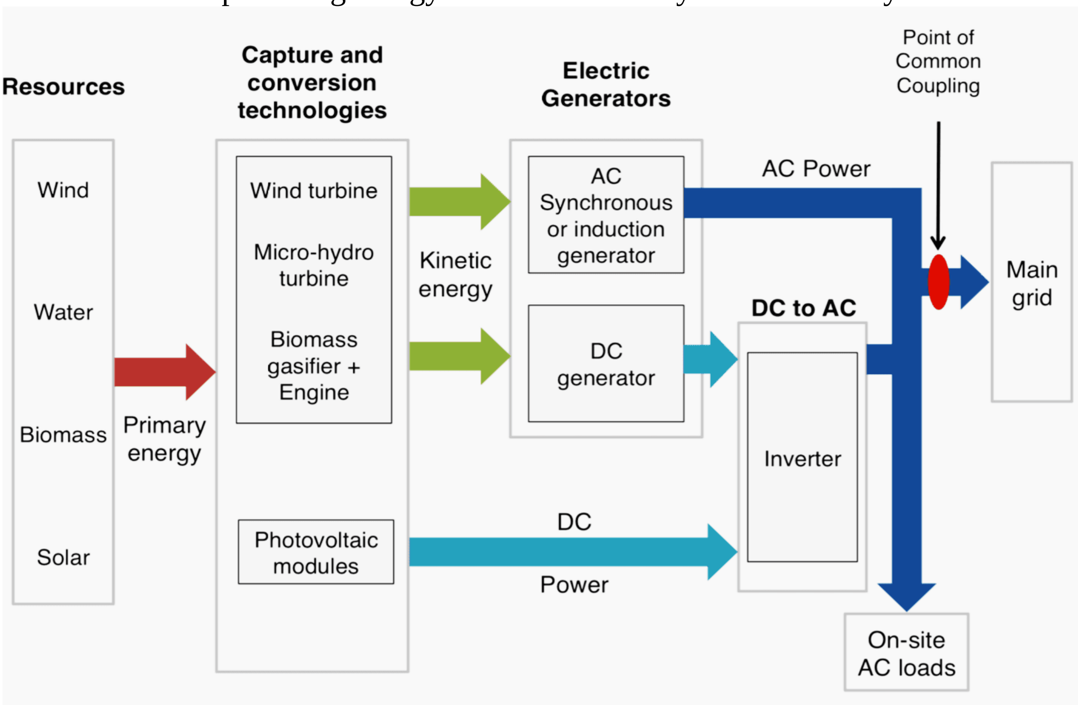

Figure 3 Mini grid scheme

of progress.

Increase access to electricity as microgrids can provide a solution by generating electricity in remote areas and providing access to those who are not connected to the national grid. As well is a very important fact that because microgrids may be created gradually, communities can start off small and grow over time. Moreover, to the importance for the environment that renewable energies are used, the fact that renewable energies are much less dependent on consumables will permit these communities to have access to electricity even under possible adverse events due to lack of communication or resources. [11]

Energy security and independence may allow areas with frequent blackouts to settle a reliable source which will develop and settle a new mindset on the population about electricity, their use, and benefits.

The benefits of a change in mindset came from the new opportunities raise from a reliable energy supply. The main reasons why lack of energy is a main issue are:

Firstly, limited productivity, because of the inability to operate machinery, tools, and equipment that depend on electricity to function, companies' manufacturing capacity is constrained, which lowers productivity. Along with the lack of productivity the lack of energy supply may have an impact on the quality of life for residents in a certain area. Without energy, people are unable to use essential amenities like lights, hot water, cooling, and warmth. Their general health, safety, and well-being may be negatively impacted by this.

In addition, absence of power can interfere with communication among organizations, institutions, and people. Most companies and social networks require power to run. It might be challenging to communicate with those outside of the impacted area without electricity. And finally, the innovation is totally slowed down by a lack of supply. The capacity of businesses to innovate and create new technology may be constrained if they rely on power for research and development.

B. METHODOLOGY AND OBJECTIVES

B.1 METHODOLOGY

The following pages will survey the situation of mini grids in rural India. First, the different possible characteristics of the mini grids as well as their global situation will be presented. Secondly, the demographic, social, and economic situation in India will be introduced, which is extremely relevant for the long-term viability of the project.
After this contextualization, the financial model of the study will be presented, analysing different cases, modifying sensitivities, and using different levers of change. The model will provide us with the economic viability of the project, from which we will be able to draw the conclusions of this project.

B.2 OBJECTIVES

1. The creation of a financial statement analysis

The prime priority is the design of a financial model that could support identifying if the project is financially sustainable and test the model's sensitivity and likelihoods.

The future viability of the project will be determined through a NPV cases study analysis.

2. Identification of the sensibilities or leverages used.

To assess an investment's viability, the sensitivity analysis of an investment involves taking into consideration its financial components. This study can be used to predict how an investment will behave under various economic conditions and in the presence of multiple variables.

It is therefore imperative to identify the best conditions and variables presented by the project carried out in the geographical context of India.

3. Explanation and enhancement of minigrids using the model in real-world situations.

The balance sheet will be designed to allow to delimit the profit ranges of the project final balance sheet, which will be fed with different possibilities and alternatives. The purpose is set in looking for the conditions of India that allows the maximum economical profit. Sensitivities, or various adaptations, will be applied, including adaptability to local conditions, a variety of supply sources, and the potential for aid and subsidies.

4. Conclusions about the economic viability of the minigrids

Conclusions from the financial model, analyzing the net present value the sum that such an investment will bring in in the future. Understanding that the true worth of money fluctuates over time.

C. MINIGRIDS

C.1 CLASSIFICATION OF MINIGRIDS

Mini grids can be classified in an infinite number of ways due to their flexibility and adaptability, which makes them a great answer to a wide variety of problems. There are multitude of classifications of minigrids based on their social impact, power sources, or financial model among others. [12]

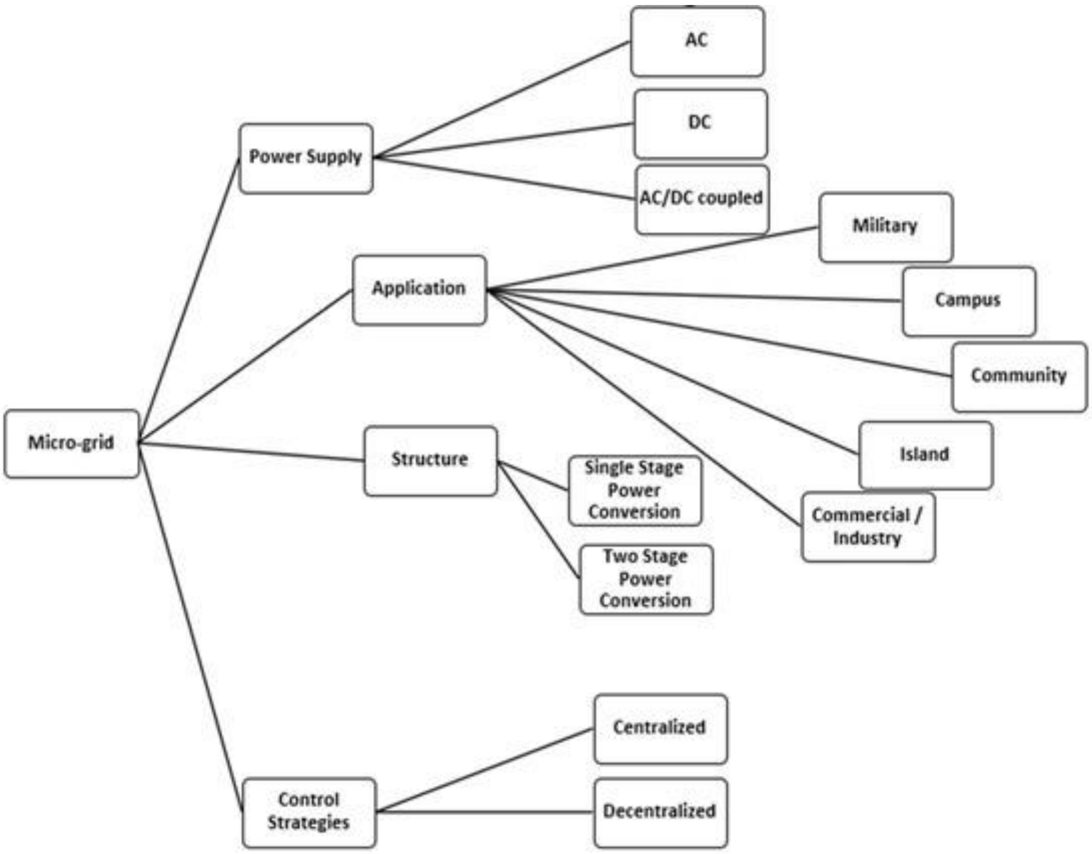

Figure 4 Microgrid categorization

C.2 POWER SOURCE

• Solar minigrids: These minigrids produce power using solar panels. They are becoming more popular in locations with plenty of sunshine since they are cost-effective, dependable, and ecologically benign.

• Hydro minigrids: These minigrids produce electricity using hydropower. These are perfect for regions where there is flowing water, such as rivers or streams.

• Wind minigrids: These minigrids produce power using wind turbines. They are appropriate for high-wind locations.

• Diesel minigrids: These minigrids produce power using diesel generators. They are frequently utilized in distant regions when other forms of electricity are unavailable.

• Hybrid minigrids: These minigrids create energy by combining different power sources, such as solar, wind, hydro, and diesel. They are appropriate for places with fluctuating weather and electricity requirements. [13]

C.3 FINANCIAL MODEL

Minigrids can be classified based on their financial models, there are numerous financial models or methods for developing nations to pay for or fund mini grids. [14] [15] [16]

- RBF (results-based financing) model: This concept links money to specified outcomes, such as expanded access to power or improved livelihoods. This can assist guarantee that funding is tied to measurable outcomes and can promote the provision of high-quality services.
- Performance-based grant model: Under this approach, mini-grid operators receive grants depending on their performance, such as the number of homes connected, or the quantity of power generated. This can assist to motivate operators to deliver high-quality services and secure the mini-long-term grid's viability.

- Model of pay-as-you-go (PAYG): Customers pay for power on a pay-as-you-go basis using mobile money or other digital payment methods under this concept. This strategy has the potential to minimize the initial cost of establishing mini grids while also making power more accessible for low-income clients.

PAYG models require customers to pay for electricity in small increments, while prepaid models require customers to pay in advance for a certain amount of electricity. Postpaid models bill customers after they have used the electricity.

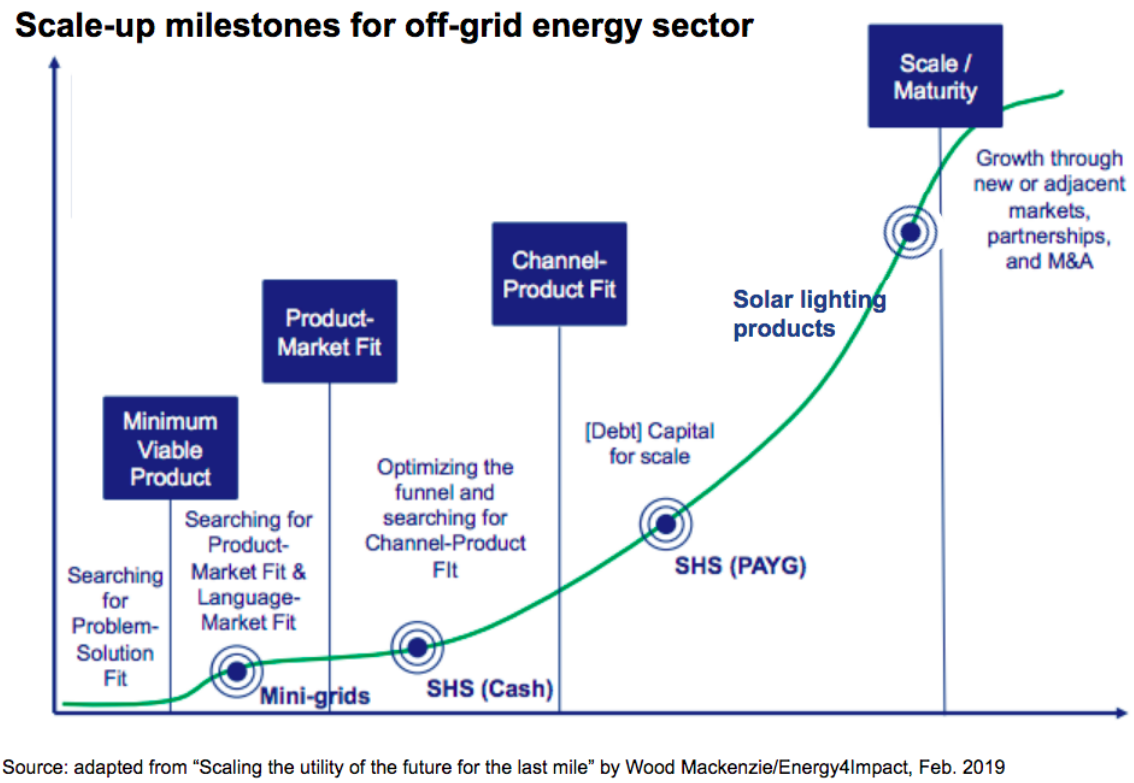

Figure 5 Off- grid scale-up milestone

- Franchise mini-grids: These mini-grids are often funded by a combination of public and private investments, such as grants, loans, and equity investments. A franchisor owns and operates these mini-grids, while a franchisee manages day-to-day operations. [11]

- Blended finance mini-grids: These are mini-grids that are funded by a combination of public and private investments, with the goal of maximizing both. These mini-grids are often funded by a combination of grants, concessional loans, and commercial ventures. [17]
- Grid-connected mini-grids: These are mini-grids that are linked to the main power grid, either as a backup power source or to sell excess electricity back to the grid. These mini-grids are often funded by a combination of public and private capital, including grants, loans, and equity investments.
- Microfinance-backed mini-grids: These are mini-grids that are funded by microfinance organizations (MFIs), which give users loans to buy solar home systems or mini-grid connections. These mini-grids are often funded by a combination of public and private capital, including grants, loans, and equity investments. [18]
- Result-based financing mini-grids: These are mini-grids that are funded based on certain outcomes, such as expanding electricity availability or lowering greenhouse gas emissions. These mini-grids are often financed through a combination of public and private investments, such as grants, loans, and equity investments, with payments made based on the attainment of pre-determined milestones. [19]

C.4 SOCIAL IMPACT

Minigrids based on their social impact, such as whether they promote gender equity, create jobs, or improve health outcomes. Some minigrids may prioritize social impact as a primary goal, while others may focus primarily on providing reliable and affordable electricity. [20]

- Better education: Availability to electricity may also bring educational possibilities, since schools can be illuminated and equipped with computers and other electronic resources. This can assist to overcome the digital divide between urban and rural locations.

- Improved health outcomes: Mini grids can power health clinics and hospitals, increasing access to healthcare for individuals living in distant places. This can lead to improved health outcomes and a decrease in new-born death rates. [3]
- Entrepreneurship: The building and operation of mini grids can provide jobs in rural regions, stimulating economic growth and raising local living standards.

Mini-grids that employ renewable energy sources like solar and wind power can assist to reduce carbon emissions and minimize the effects of climate change.

C.5 OTHER IMPORTANT CONSIDERATIONS

1. **Ownership Model**
    a. Community-owned-minigrids: These are minigrids owned and controlled by local communities, such as cooperatives or community-based groups. These mini-grids are often funded by a combination of public and private capital, including grants, loans, and equity investments.
    b. Publicly owned mini-grids: These are mini-grids that are owned and operated by government institutions such as state-owned utilities or rural electrification organizations. These mini-grids are often funded by government budgets or loans from foreign financial organizations.
    c. Privately owned mini-grids: These are mini-grids owned and run by private firms such as energy service companies (ESCOs), independent power producers (IPPs), or community-based groups. These mini-grids are often financed by private investments, such as equity or debt funding from investors or development banks. [21]
2. **Scale**

Minigrids can be classified into different scales based on their capacity and the size of the community they serve. which in fact is a classification of the energy access level the grid allows access to. Some grids may provide basic energy access for lighting and phone charging, while others may provide higher levels of energy access for productive uses like irrigation, refrigeration, and machinery.

Table 3 Scales denomination related to their power.

The most common scales denominations	The power (W)
pico	up to 10 kW
micro	10 kW - 100 kW
mini	100 kW - 1 MW
small	1 MW - 10 MW

In this context we can see the regulatory framework of the grid how some countries have established policies and regulations specifically for minigrids, while others may not have clear regulations or may require the minigrids to follow the same rules as the main grid.

The main problems lack of regulation leads to are coverage, permission for doing business, eligibility requirements, conditions of supply, and tariff-related issues:

3. Application

Minigrids can also be classed based upon their intended use, such as residential, commercial, or industrial. [22]

a. Residential minigrids are designed to provide electricity to households,
b. Commercial and industrial minigrids are designed to power businesses and factories.

4. Technology

Minigrids can also be classified based on the technology used to distribute electricity, such as AC or DC systems, DC grids are becoming more popular due to their ability to efficiently store and distribute energy. [3]

5. **Connectivity**

   Minigrids can be connected or isolated from the main grid. Connected minigrids are linked to the main grid and can provide excess electricity to the grid, while isolated minigrids are not connected to the main grid and are self-sufficient.

6. **Storage**

   Minigrids can be classified based on whether they include energy storage or not. Storage can be used to store excess electricity generated during peak times for use during periods of low generation or high demand.

7. **Control system** [9]

   Minigrids can also be classified based on the type of control system used to manage the distribution of electricity. Smart minigrids use advanced control systems and communication technology to monitor and optimize the operation of the minigrid, [23] while traditional minigrids use simpler control systems.

8. **Environmental impact**

   Minigrids can be classified based on their environmental impact. Renewable energy-based minigrids have a lower environmental impact than diesel-based minigrids, which produce greenhouse gases and other pollutants.

9. **Maintenance and operation**

   Minigrids can be classified based on the level of maintenance and operation required. Some minigrids may require constant maintenance and repair due to harsh environmental conditions, while others may be more durable and require minimal maintenance. [7]

10. **Integration with other energy systems**

    Minigrids can be classified based on their integration with other energy systems, such as solar home systems, grid extensions, and diesel generators. Some minigrids may be designed to complement other energy systems, while others may be designed to replace them. [24]

11. **Reliability**

Minigrids are characterized based on their dependability, or their ability to continuously supply energy. Certain minigrids may face frequent outages owing to equipment failure or maintenance concerns, whilst others may be built to supply consistent power even under difficult situations.

12. Scalability

Minigrids are characterized based on their dependability, or their ability to continuously supply energy. Certain minigrids may face frequent outages owing to equipment failure or maintenance concerns, whilst others may be built to supply consistent power even in difficult situations. [24]

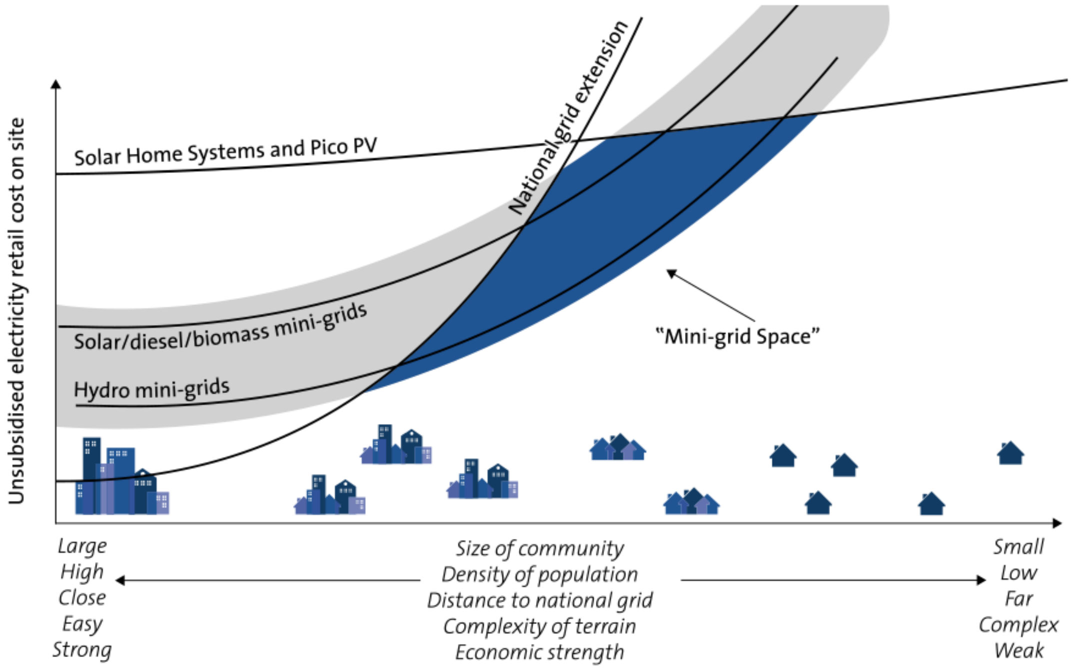

Figure 6 Mini-grid space is optimal for mid-density.

D. MINIGRIDS AROUND THE WORLD

Micrograds connect distributed energy sources to nearby end users such as households, communities, businesses, or factories. They are often operated by sophisticated computer systems capable of varying energy production according to demand. [3]

Among microgrids benefits worth mentioning are the following:

- A reduction of electricity costs, since in the case of being connected to the grid, it will only use this energy when it is cheaper.
- If regulation allows, and the microgrid is connected to the grid, it could provide an additional source of revenue by providing energy and compensated ancillary services to the national grid.
- Improved security and resilience of supply for microgrid users, thanks to the possibility of use when a disconnection from the national grid in the event of a critical load or power outage. In the context of poorly electrified areas, the microgrid may become essential for a reasonable service.
- Optimization of the energy costs of the national grid.

Despite the opportunities offered by mini grids, there are also challenges that must be addressed. For example, their market uptake continues to be limited in most developing countries.

In Asia the greatest development of mini-grids has been in China, where an estimated 60,000 systems are in place, but also in Nepal, India, Vietnam, and Sri Lanka minigrids have been growing consistently, having a range of 100 to 1,000 mini-grids each. However, most of these systems operate on diesel or hydropower and are managed and maintained by the government; thus, these systems are in most of the cases operating at loss-making, loss which is covered by the rest of the national network.

The Africa minigrids program (AMP). was inaugurated during the United Nations Climate Conference COP27. The AMP is a country-led technical assistance initiative that helps governments supply power and new development possibilities to some of Africa's poorest communities in an efficient and cost-effective approach. The Global Environment Facility (GEF) led the funding, which was implemented by UNDP in collaboration with national governments, and the African Development Bank (AfDB). The AMP's market transformation approach aims to assist countries in crowding in private investment to scale up and accelerate the deployment of renewable energy minigrids.

The European situation of the mini grids and off-grid systems are not as widespread in Europe as they are in developing nations with limited or non-existent access to energy. Most residences and companies in Europe are connected to the main power grid, which offers a reliable and economical supply of energy. Yet, mini-grids or off-grid systems are required in some remote and isolated areas of Europe, such as islands or hilly regions. [25] [26]

E. INDIA´S SITUATION

E.1 INDIA'S ECONOMIC PLACE

India's GDP after the epidemic, increased by 9.1% in fiscal 2022. And the preliminary estimate for previous fiscal year's growth is now 7.2% (down from 7%). Because of global obstacles, expect 6% growth in this fiscal year 2023. [27]

The uprising India's economy is still blocked by widespread national poverty, low purchasing power and areas of low human development. Minimum wages in India are established in a decentralized form, with each state deciding its own rates. Rates might vary greatly between states and sectors. As a result, minimum wage rates in urban and rural areas might vary dramatically. It is crucial to remember that minimum salaries may not always afford a decent level of living, especially in higher-cost-of-living places. [28] [29]

In India, the average income varies greatly. The presence of industry and the greater cost of living, major metropolitan cities such as Mumbai, Delhi, and Bangalore often have higher average incomes. Statistical reports and surveys conducted by reputable institutions like the National Sample Survey Office (NSSO) and economic research organizations can also provide valuable insights into wages in India. [30] [31] Macroeconomically and based on GDP data and estimates, we can look at this table, analysing the GDP, GDP per capita, GDP growth, inflation rate, unemployment, and government debt.

Tabla 2 Macroeconomical data of India each year from 2017 to 2027

Year	GDP (in Bil. US$PPP)	GDP per capita (in US$ PPP)	GDP (in Bil. US$nominal)	GDP per capita (in US$ nominal)	GDP growth (real)	Inflation rate (in Percent)	Unemployment (in Percent)	Government debt (in % of GDP)

2017	▲ 8,276.9	▲ 6,112.1	▲2,702.9	▲ 1,958.0	▲6.8%	▲3.6%	▬5.4%	▲69.7%
2018	▲ 9,023.0	▲ 6,590.9	▲2,702.9	▲ 1,974.4	▲6.5%	▲3.4%	▼5.3%	▲70.4%
2019	▲ 9,540.4	▲ 6,897.8	▲2,835.6	▲ 2,050.2	▲3.9%	▲4.8%	▼5.3%	▲75.0%
2020	▼ 9,101.3	▼ 6,517.8	▼2,671.6	▼ 1,913.2	▼- 5.8%	▲6.1%	▲8.0%	▲88.5%
2021	▲ 10,370.8	▲ 7,355.4	▲3,150.3	▲ 2,234.3	▲9.1%	▲5.5%	▼6.0%	▼84.7%
2022	▲ 11,855.4	▲ 8,329.3	▲3,386.4	▲ 2,379.2	▲6.8%	▲6.7%	▲8.3%	▼83.1%
2023	▲ 13,033.4	▲ 9,073.0	▲3,736.9	▲ 2,601.4	▲5.9%	▲4.9%	▼7.8%	▲83.2%
2024	▲ 14,165.5	▲ 9,773.0	▲4,062.2	▲ 2,802.5	▲6.3%	▲4.4%	n/a	▲83.7%
2025	▲ 15,330.6	▲ 10,484.8	▲4,547.2	▲ 3,146.8	▲6.9%	▲4.1%	n/a	▼83.8%
2026	▲ 16,563.8	▲ 11,232.6	▲4,765.5	▲ 3,231.7	▲6.1%	▲4.1%	n/a	▼83.8%
2027	▲ 17,877.0	▲ 12,024.0	▲5,153.0	▲ 3,465.9	▲6.0%	▲4.0%	n/a	▼83.7%

Based on the facts presented in “Table 2”, India's future economic prospects look optimistic. India has the potential for ongoing growth and development due to its big and varied economy. Despite obstacles like as income inequality and unemployment, the government's measures to boost economic activity and attract investment, together with continuing reforms, present prospects for growth. As the economy grows, there is the possibility for more job creation, greater earnings, and higher living standards for the public.

E.2 INDIA’S DEMOGRAPHICS AND METEOROLOGY

For a variety of reasons, it is essential to consider India's demographics and climatic circumstances while developing minigrids.

To begin with, India has a big and diversified population, with a sizable share of the people residing in rural regions. These communities frequently lack consistent energy, and minigrids can be an efficient method to provide them with clean, affordable power. Second, India has a large diversity of climatic variables that might affect mini grid performance and efficiency. For example, high temperatures can diminish the effectiveness of solar panels, and mini grid infrastructure may be jeopardized in flood-prone locations.

India is a South Asian country with a population of approximately 1.3 billion people. India's demographics are diversified, with a wide range of ethnic groups, religions, languages, and more important wide differences among social classes, and between rural and urban areas.

According to the World Bank, over 65% of India's population resided in rural regions in 2021. Rural India's growth rate has slowed over the years, and it is now projected to be approximately 1.1% each year. [32]

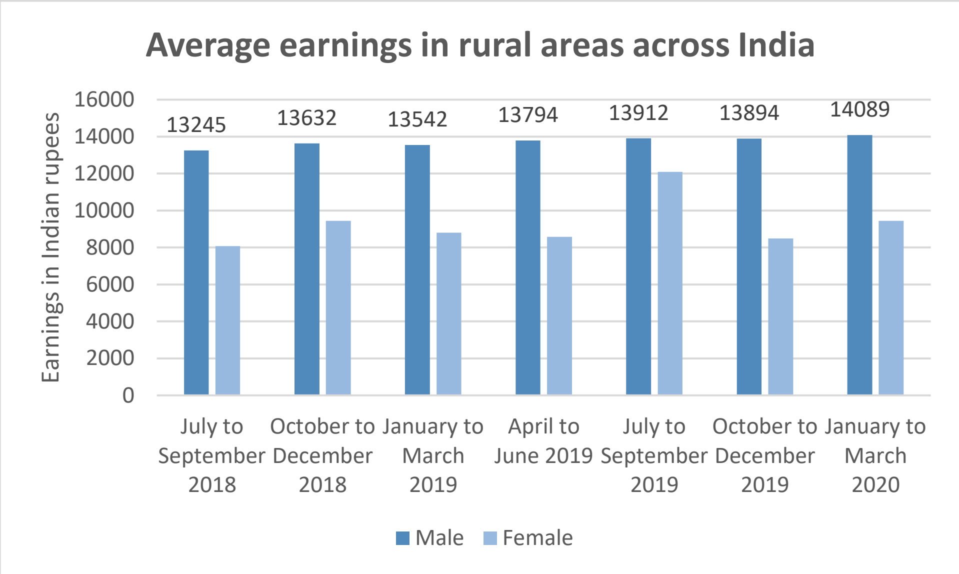

Figure 6 Average earning in rural India

Despite the decreasing growth rate, India's rural population is likely to expand in the future years due to natural population growth and migration from metropolitan regions. Yet, an increasing trend of reverse migration is occurring, with great groups of individuals returning to rural regions in quest of a better quality of life.

[33]Living circumstances in rural India can vary greatly based on variables such as availability to essential facilities: water, sanitation, and healthcare. In recent years, the Indian government has launched several programs to enhance the quality of life in rural regions, including the Pradhan Mantri Awas Yojana (PMAY), which aims to provide affordable housing units for rural people.

Power availability in rural India has also been a difficulty, with over 30 million families still lacking access to electricity as of 2021. Even though, the government has set high aims for promoting energy availability, with the goal of reaching 100% electrification by 2022 through projects such as the Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) and the Saubhagya programme.

E.3 INDIA'S GRID SITUATION

India's electricity industry is one of the largest in the world, with 380 GW of installed capacity as of 2021. Yet, the country faces considerable hurdles in fulfilling its rising energy consumption. One of the most difficult issues is the imbalance between power supply and demand. While installed capacity is large, actual availability of energy is substantially lower owing to a variety of problems such as transmission losses, equipment breakdowns, and a shortage of fuel supply.

Coal-fired thermal power plants dominate India's electricity generating mix, accounting for around 63% of installed capacity. In quite a while, the government has increasingly concentrated its efforts on the development of renewable energy sources such as solar and wind power. India has set a target of 175 GW of renewable energy capacity by 2022, with solar power accounting for 100 GW of that total. India had constructed 40 GW of solar capacity and 39 GW of wind capacity as of 2021.

The state-owned Power Grid Corporation of India Limited (PGCIL) manages India's electrical grid and runs and maintains the transmission infrastructure. The grid is linked and extends across a large geographical region. High voltage (HV) and extra high voltage (EHV) transmission lines are used in the transmission network to transport power across great distances. In contrast, the distribution network consists of lower voltage wires that distribute power to households and businesses.

Despite the grid's scale and complexity, India has experienced power shortages, blackouts, and voltage variations, particularly during peak hours. To solve these vulnerabilities, the Indian government has launched several efforts, such as encouraging renewable energy, enhancing the efficiency of thermal power plants, and updating grid infrastructure.

Transmission and distribution losses, which are caused by technical factors like transmission line resistance, impedance, and capacitance, are one of the primary difficulties confronting India's power sector. Transmission and distribution losses in India are expected to reach over 19% by 2020. To solve this issue, the government has initiated a number of measures, including smart grid projects and the installation of improved metering infrastructure (AMI).

The cost difference between mini grids and national grids varies widely depending on various factors such as the location, technology used, scale, and complexity of the system, as well as the local regulations and policies.

In India, the cost of power from mini grids is indeed, greater than the cost of electricity from the national grid, according to recent research and publications. This is common elsewhere since mini grids cannot exploit the economies of scale of a capital-intensive sector such as the provision of electricity. Here are some ballpark figures for the price of power in India from micro grids and the main grid:

- The cost of electricity from mini grids in India can range from $0.15 to $0.30 per kilowatt-hour (kWh), depending on the technology used, the location, and other factors.
- The average cost of electricity from the national grid in India is around $0.05 to $0.10 per kWh, but it can vary significantly depending on the region and other factors.

It is essential to keep in mind that these are only rough estimates, especially, if we consider the costs associated to lack of quality and interruptions of supply from the main grid. In addition, the price of energy is continually fluctuating because of several factors, including changes in regulations, market conditions, and technical improvements.

Another problem concerning India's electrical supply business is the underutilization of thermal power assets, which results in lower efficiency and higher pricing. In 2020, India's average capacity utilization of coal-fired thermal power plants was at 55%, far lower than the worldwide norm of 60–65%. To address this problem, the government has implemented initiatives such as the Ujwal DISCOM Assurance Yojana (UDAY), which aims to improve the financial and operational efficiency of power distribution companies (DISCOMs).

In addition to these concerns, India's power industry is dealing with fuel supply issues, particularly for coal-fired power plants. India is significantly reliant on coal imports, which can be impacted by worldwide price swings and supply interruptions. To solve this issue, the government has undertaken efforts such as the "One Billion Tonnes" program of Coal India Limited, which attempts to enhance domestic coal output to meet rising demand.

Likewise, the integration of renewable energy sources into the grid poses issues for the Indian power industry. Renewable energy sources, such as solar and wind power, are intermittent in nature, which can have an impact on the grid's stability and dependability. To solve this issue, the government has developed programs such as the Green Energy Corridor Project, which intends to build a specialized renewable energy transmission infrastructure.

Notwithstanding these obstacles, India's electricity industry has advanced significantly in recent years. The country has nearly universal access to power, with electrification expanding from 70% in 2014 to 100% in 2019. The Indian government has also created many energy-efficiency programs, such as the Perform, Achieve, and Trade (PAT) plan, which pays incentives to enterprises that cut their energy use. The Bureau of Energy Efficiency (BEE) has also implemented star rating labeling for equipment like air conditioners, refrigerators, and televisions to assist consumers in making more energy-efficient choices.

[34] Among these plans we observe a clear tendency for renewable energies as is shown in several initiatives and plans to promote solar energy and increase the country's solar capacity.

National Solar Mission: The National Solar Mission was established in 2010 with the goal of encouraging the growth and utilization of solar energy in the country. The program originally established a target of 100 GW of solar capacity by 2022, but that aim has now been raised to 450 GW by 2030

The Ministry of New and Renewable Energy (MNRE) has announced a plan to build ultra-mega solar farms around the nation. These solar parks will have a capacity of 500 MW or more and will offer project developers with infrastructure such as land, transmission, and evacuation facilities. As well the MNRE has started a program to promote rooftop solar panel installation on residential, commercial, and industrial structures. The plan provides financial incentives to households to install rooftop solar panels and has set a target of 40 GW of rooftop solar power by 2022.

[35]The Ministry of Agriculture and Farmers Welfare has established a program to encourage the usage of solar-powered irrigation water pumps. Farmers are eligible for incentives to acquire solar water pumps, which are more cost-effective and environmentally benign than diesel-powered pumps. The Ministry of Micro, Small, and Medium Enterprises has begun a

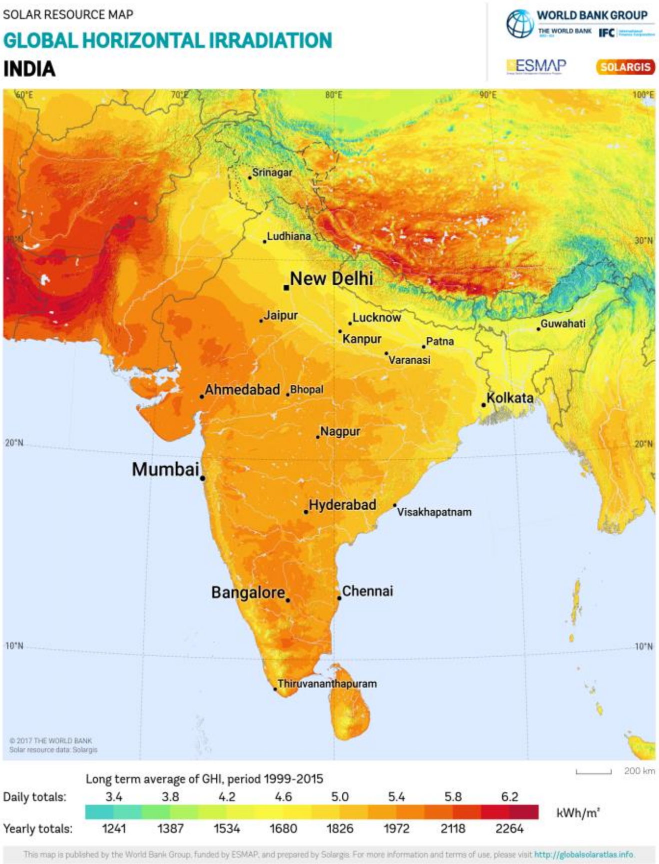

Figure 7 India solar atlas [47]

campaign to encourage the use of solar-powered charkhas (spinning wheels) for khadi manufacture (handspun cotton). The mission's goal is to give employment possibilities to rural craftsmen and encourage the use of solar energy in the textile sector.

The monsoon season lasts from June to September and accounts for most of the country's rainfall. Natural calamities such as cyclones, floods, earthquakes, and droughts may also devastate India's infrastructure. The government has taken several steps to address these issues, including establishing the National Disaster Management Authority to coordinate emergency management operation.

In this juncture, electrical minigrids allow us to seek possible solutions that will be positive for the population, environmentally friendly and forward-looking.Taking these considerations into account, it is feasible to develop and install minigrids that are adapted to the unique demands of the local people and capable of operating efficiently and effectively in the local climatic circumstances. This can assist to enhance access to energy, improve living conditions, and encourage long-term development in India's rural areas.

E.4 INDIA´S GRID DEVELOPMENT AND ELECTRICAL NEEDS

India is one of the world's fastest-growing economies and has a rapidly changing demographic. The country is predicted to overtake China as the world's most populated nation by 2027. With this influx of people, India's electricity consumption as well as industrialization is consequently rapidly developing.

Accessibility to dependable, accessible energy is vital for economic development and enhancing people's quality of life. In India, a sizable segment of the population still appears to lack access to electricity service, particularly in rural regions. According to the International Energy Agency (IEA), around 200 million people in India lack access to electricity, and many more face regular power shortages. To accommodate India's increasing demand for power, the government has established the objective of providing universal access to energy by 2025. This includes boosting capacity for electricity generation, extending transmission and distribution networks, and encouraging the use of renewable energy sources.

Increased access to energy and the development of electrical infrastructure may help drive economic growth and offer job opportunities, particularly in the industrial and service sectors. This can contribute to greater general development and raise the level of living in India. But it is critical to guarantee that this development is long-term and inclusive, and that the benefits

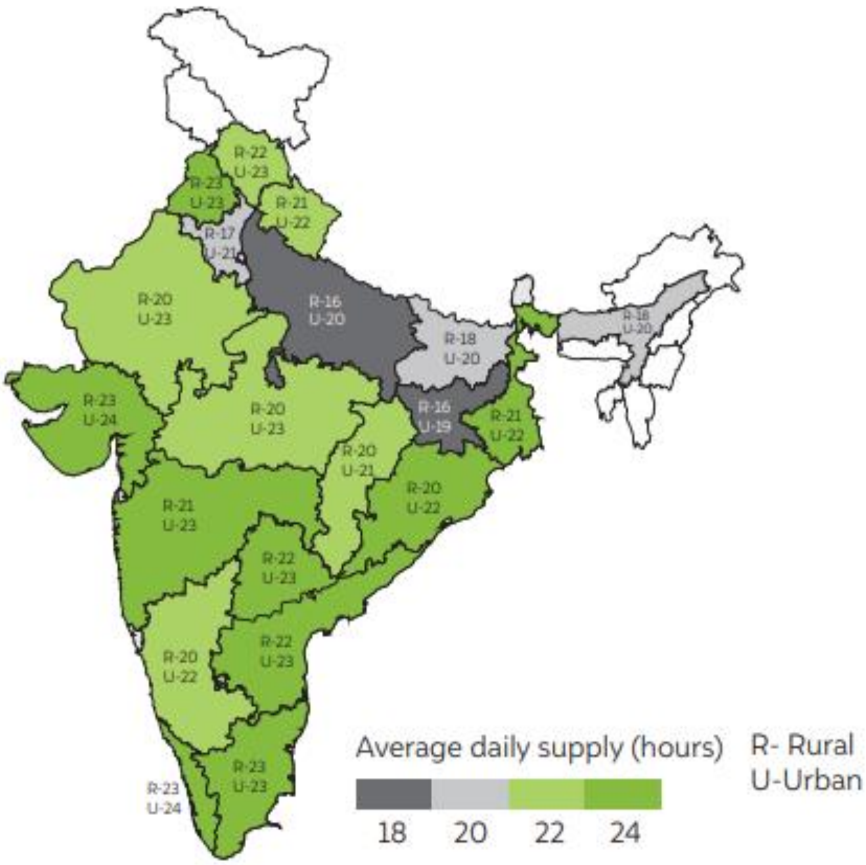

Figure 8 Daily duration of electricity supply

are dispersed equally across society. The differences in development between rural and urban areas are also shown in the electricity available by region, and even within the same regions there is a notable difference between urban and rural areas.

In this context of development, the government has launched various schemes and initiatives, such as the Deen Dayal Upadhyaya Gram Jyoti Yojana and the Saubhagya scheme, to improve access to electricity in rural areas. The DDUGJY supports the creation of micro-grids and off-grid solutions using renewable energy sources while the Saubhagya provides free electricity connections to below poverty line (BPL) households, and for other households, the cost is borne by the state government or the household itself. [36]

The Indian government has implemented several programs and initiatives aimed at improving rural inhabitants' living standards and stimulating rural development (DDUGJY, Saubhagya, MGNREGA, PMAY-G). Access to essential infrastructure and services such as electricity, water supply, sanitation, and transportation is one of the core national priorities.

Notwithstanding these efforts, considerable obstacles to improving the lives of rural residents in India remain. Poverty, hunger, and a lack of access to basic treatments remain key challenges, and the COVID-19 epidemic has underlined rural residents' vulnerabilities. [37]

II. FINANCIAL STUDY OF RURAL INDIA'S MINIGRIDS SITUATION

A. GRID PROBLEMS AND FINANCIAL IMPLICATIONS OF IT

Although 99% India's inhabitants are supposed to have electric power since 2020, the reality are lack of connection to the main grid and not enough capacity power to supply during the whole day.

Inadequate Power Generation Capacity: Due to fast industrialization and population growth, India has failed to fulfill rising energy demand. Inadequate power producing capacity causes frequent power outages and insufficient supply, especially during peak demand periods. Power outages can impair industrial output, commercial activity, and general economic growth, which has financial ramifications. It may also result in revenue losses for enterprises and higher backup power expenses.

Transmission and distribution losses and Grid Infrastructure Difficulties: are substantial in India's electricity infrastructure, owing to technological inefficiencies, theft, and non-payment concerns. These losses reduce power utilities' income and raise the financial burden on distribution businesses. The power industry in India has faced issues due to aging grid infrastructure, insufficient maintenance, and insufficient investment in grid modernisation. These difficulties can result in frequent breakdowns, voltage fluctuations, and system failures, which can cost utilities money in repairs, operational interruptions, and revenue losses.

The minigrids shall avoid the electricity infrastructure obstacles of connection between far away villages and the main grid that led into lack of connection to it. These obstacles may be rivers, monsoon and floods, dense forest area or accidents due to the wildlife.

Renewable Energy Integration: India's quest for renewable energy integration, notably solar and wind power, has brought grid stability and management issues. Because renewable energy sources are intermittent, complex grid management technologies and infrastructure modifications are required to enable smooth integration. Investments in smart grid technology, energy storage systems, and grid balancing techniques are among the financial ramifications.

Solving these grid issues will need significant expenditures in infrastructure upgrades, grid modernization, renewable energy integration, and financial changes. To address the financial viability of Discoms and increase operational efficiency, the government has launched several programs and regulatory initiatives, including the Ujwal DISCOM Assurance Yojana (UDAY). However, to accomplish long-term improvements in India's electricity grid and alleviate the cost ramifications associated with grid difficulties, these projects require large financial resources and long-term planning.

B. FINANCIAL LEVERS AND TAX DEDUCTION

B.1 FINANCIAL LEVER

Financial leverage basically consists of borrowing to invest and it is use by companies and individuals, and shall be a solution to the expenditure's procedures exposed in the "Chapter 1 Grid problems and implications of it"

Financial leverage operates on the premise that if the return on investment (ROI) exceeds the cost of borrowing, the investor or firm will benefit from improved profitability. It does, however, magnify possible losses if the investment does not perform as predicted.

It's worth noting that, while financial leverage might boost prospective rewards, it also raises risk. If the profits on investments or commercial activities are insufficient to meet the cost of borrowing, it can lead to financial troubles or even bankruptcy. When utilizing financial leverage, prudent risk management and rigorous analysis of the cost and possible rewards are critical. [38]

B.2 INDEX OF FINANCIAL LEVER

Assessing the level of risk tolerance is crucial when deciding which financial levers to use. In this case due to a corporation and the social implications of the project we would work with a mixture of debt financing and raising funds.

→ **Debt financing**: Borrowing money in the form of loans, lines of credit, or bonds can offer quick access to funds for investments or business operations. It can be used to fund growth, purchase assets, or meet cash flow requirements. However, rigorous debt management is required to ensure the capacity to service debt commitments.

→ **Raising funds** by issuing equity shares or soliciting investment from venture capitalists, angel investors, or crowdfunding platforms is an example of equity financing. Outside investors that supply capital in return for ownership holdings might be brought in via equity financing. This can be a good strategy to fund development without incurring debt, but it may result in ownership dilution and loss of control.

→ **Leasing and asset finance:** Rather of buying assets outright, leasing or asset financing might be used. This enables you to access and use assets while spreading payments out over time. It is especially effective for purchasing expensive equipment, automobiles, or machinery without a huge initial capital investment.

→ **Mergers and acquisitions**: Combining firms or acquiring strategic assets can be a financial tool for expanding market reach, gaining synergies, or gaining access to new skills. To secure good outcomes, this technique involves extensive due diligence, value research, and integration planning.

→ **Financial derivatives**, such as options, futures, or swaps, can give possibilities to hedge against risks, control interest rate exposure, or speculate on price changes. Derivatives, on the other hand, may be complicated instruments that must be employed with a thorough grasp of their mechanics and accompanying risks.

Of these possible options, we will focus on debt financing, fund raising and asset leasing. These options will be reflected in the following categories determined by the cost of raising finance.

- Non-refundable financing:
- Non-profit and non-interest-bearing financing:
- Fixed-rate financing:
- Financing through crowdfunding:
- Financing through green bonds:

- Financing through social venture capital

Table 4 Differnet fianancial leverage studied in the model

Tabla 2 Leverage			
Leverage id	**Index of financial leverage**	**Interest**	**range % interest**
1	Non-refundable financing	-1	[-100-0]
2	Non-profit and non-interest-bearing financing	0,02	[0-4]
3	Fixed-rate financing	0,07	[5-12]
4	Financing through crowdfunding	0,04	[3-7]
5	Financing through green bonds	0,05	[3-6]
6	Financing through social venture capital	0,1	[8-15]

B.3 NON-REFUNDABLE FINANCING

This type of financing does not require the payment of interest or repayment of principal, so there is no leverage cost in this case. It can be obtained from government programs, NGOs, or other organizations; however, it may be difficult to obtain due to the high demand and competition. The non-refundable financing can cover the 100% of the projects cost or just a smaller amount of it.

Flexibility and risk mitigation are the main advantages of non-repayable financing for the projects it supports. As it could sound idealist, the fact is that having a reliable and powerful grid may report benefits to the India’s government through the taxes of the new enterprises and business which will grew covered by the umbrella of the mini grid.

Non-profit and non-interest-bearing financing:

- Non-profit organizations or impact investors provide zero-interest loans or credit facilities to fund the installation and operation of minigrids in remote and neglected parts of India.

- Donations made by non-profit organizations to fund the operating expenditures and community development activities related with minigrid projects in India.
- Subsidized funding schemes provided by government agencies or development banks to enable non-profit groups to build minigrids projects without interest cost.
- Partnerships with non-profit foundations or organizations that provide technical help, capacity-building aid, or access to networks and resources to progress minigrids initiatives in India.

B.4 NON-PROFIT AND NON-INTEREST-BEARING FINANCING.

Although this type of financing has no interest cost, there may be other associated costs, such as commissions or administrative fees. The leverage cost could be around 2-4% of the capital borrowed.

Zero-interest loans or credit facilities extended by non-profit organizations or impact investors to finance the construction and maintenance of minigrids in remote and underserved areas of India.

Donations or grants provided by non-profit entities to support the operational costs and community development initiatives associated with minigrid projects in India.

Subsidized financing programs offered by governmental agencies or development banks to enable non-profit organizations to implement minigrid projects with minimal interest burden.

Partnerships with non-profit foundations or organizations that offer technical assistance, capacity-building support, or access to networks and resources to advance minigrid projects in India. [39]

B.5 FIXED-RATE FINANCING

Leverage costs for fixed-rate loans vary by lender and interest rate. In general, fixed interest loans can have leverage costs ranging from 5% to 12%

- Payment Predictability: One of the key benefits of fixed-rate financing is that it gives loan payment predictability and stability. Borrowers know precisely how much their monthly payments will be throughout the loan period, making budgeting and financial planning easier.

- Protection against Interest Rate Fluctuations: By locking in a fixed interest rate, borrowers are shielded from any market interest rate rises. Even if interest rates rise in the future, the borrower's loan payments will remain the same, assuring affordability and removing the danger of growing interest expenses.

- Long-Term Planning: Fixed-rate financing is especially advantageous for long-term loans, such as mortgages since it allows borrowers to plan their finances and budget over a long period of time without the unpredictability of fluctuating interest rates.

- Comparison and evaluation: Fixed-rate financing allows customers to simply evaluate multiple loan offers from various lenders. Because the interest rate remains constant, assessing and evaluating loan possibilities based on other aspects such as fees, terms, and repayment circumstances becomes easier.

The main idea of this type of financing are:

Commercial banks or financial organizations providing long-term loans with set interest rates to support the construction and operation of minigrid projects in India.

Fixed-coupon bond issuances aimed at institutional investors interested in supporting renewable energy and rural electrification programs, providing reliable funding for minigrid projects. Agreements to offer fixed-rate loan finance for minigrid projects in India with impact-focused investors or venture capital firms. Partnerships between the public and private sectors that use fixed-rate financing mechanisms to attract private investors and assure long-term financial stability for minigrid projects in India.

B.6 FINANCING THROUGH CROWDFUNDING

Leverage costs for financing through crowdfunding can vary significantly depending on the crowdfunding platform and market conditions. In general, leverage costs in the range of 3% to 7% can be expected.

Crowdfunding campaigns on dedicated platforms to raise funds from individuals, communities, and impact-focused investors who are passionate about supporting minigrid projects in India.

Pre-selling electricity credits or discounted subscriptions for minigrid services through crowdfunding platforms to generate upfront financing for project development.

Equity crowdfunding campaigns that offer shares or ownership stakes in minigrid projects, allowing investors to contribute to and benefit from the project's success.

Rewards-based crowdfunding campaigns that provide incentives such as exclusive access to minigrid services, project updates, or community engagement opportunities in exchange for financial contributions. [40]

B.7 FINANCING THROUGH GREEN BONDS

Leverage costs for green bonds are typically lower than traditional bank loans, as investors are willing to accept lower interest rates due to the sustainable nature of the project. Leverage costs could be in the range of 3% to 6%.

Issuance of green bonds by project developers or financial institutions, specifically earmarked for financing renewable energy minigrid projects in India.

Investments from institutional investors or funds focused on sustainable and climate-friendly projects, who allocate capital to green bonds supporting minigrid initiatives.

Collaborations between minigrid project developers and green bond issuers to structure financial instruments that align with the goals of sustainable energy access and rural electrification in India.

Support from multilateral development banks or climate finance institutions that have dedicated green bond programs to mobilize capital for minigrid projects, leveraging their expertise and networks in the renewable energy sector. [41]

B.8 FINANCING THROUGH SOCIAL VENTURE CAPITAL

The leverage cost for social venture capital can vary depending on the deal and market conditions. In general, the leverage cost could range from 8% to 15%. It is important to remember that social venture capital may also require an equity stake in the company or project, which may limit the flexibility of the venture.

Investments from social venture capital businesses that prioritize effect above financial rewards, funding minigrid initiatives in India.

Funding from impact-focused angel investors or high-net-worth people interested in assisting rural electrification and sustainable energy access programs.

Collaborations between minigrids project developers and social venture capital firms to use their experience, networks, and resources to scale up and extend minigrids operations in India.

B.9 TAX DEDUCTION

Tax breaks for renewable energy are an important policy tool used by governments to incentivize the adoption and development of clean energy sources, including those related to minigrid projects. [42] [3]

To promote renewable energy, the Indian government has created a variety of tax breaks and perks, including minigrid projects.

Income earned from the generation and distribution of power from renewable energy sources is tax deductible under Section 80-IA of the Income Tax Act.

Renewable energy equipment and components used in minigrid projects are eligible for GST, Goods and Services Tax, exemptions, or lower rates.

National Rural Electrification Policies: To secure rural electrification and improve energy access in remote places, the Indian government has initiated several projects. [43]

Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya) aims to deliver electricity to every family in rural and urban regions, including through minigrid deployment.

The Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) aims to improve rural distribution infrastructure, promote off-grid options, and increase access to power in communities.

Programs for the Development of Renewable Energy: The Indian government has implemented measures to encourage the growth of renewable energy, such as minigrids, and to encourage private sector engagement. Among the notable instances are:

The Electricity Act of 2003 establishes the legal framework for electricity generation, transmission, and distribution, including provisions for off-grid and distributed generating systems such as minigrids.

The Micro, Small, and Medium Enterprises Development (MSMED) Act of 2006 encourages the growth of micro and small businesses, including those in the minigrid sector, by providing regulatory support, incentives, and access to funding.

The Ministry of New and Renewable Energy (MNRE) promotes renewable energy through several programs and incentives, such as the Off-Grid and Decentralized Solar Applications Scheme.

The Kisan Urja Suraksha evam Utthaan Mahabhiyan (KUSUM) initiative promotes the installation of solar pumps, minigrids, and other forms of renewable energy.

B.10 ACCELERATED DEPRECIATION

Accelerated Depreciation is a tax benefit available to companies that invest in renewable energy projects. It allows them to claim higher depreciation rates for their assets in the first year of operation, resulting in lower taxable income [44].

The goal of accelerated depreciation advantages is to encourage investment in renewable energy projects and to expedite the expansion of India's renewable energy sector. By increasing depreciation allowances, the government hopes to lessen the financial burden on project developers while also encouraging the use of clean and sustainable energy sources.

Accelerated depreciation advantages are provided for a variety of renewable energy sectors, including solar power, wind power, biomass energy, hydropower, and other qualified renewable energy sources. These advantages apply to both utility-scale and decentralized systems such as minigrids.

The accelerated depreciation rate varies depending on the kind of renewable energy asset. The rate is often higher in the early years of a project's existence, allowing project developers to deduct a greater percentage of the asset's value as depreciation charges. This lowers taxable income during the first few years of operation.

- Tax Benefits: By claiming accelerated depreciation, project developers can lower their taxable income, resulting in a smaller tax payment. Tax savings can be significant, especially in the early years when depreciation rates are greater. This financial gain increases the project's economic feasibility and ROI.
- Eligibility and Compliance: To get accelerated depreciation advantages, project developers must fulfill specific eligibility requirements and follow the standards established by the IRS. Documentation, certification of the renewable energy asset, and adherence to relevant legislation and processes may be included.
- Impact on Investment: The benefits of accelerated depreciation have played a crucial influence in luring investments to India's renewable energy sector. By giving a financial benefit and shortening payback times, the policy has pushed both local and foreign investors to construct renewable energy projects, including minigrids.
- Policy Changes: It is crucial to understand that tax regulations, particularly accelerated depreciation advantages, are subject to government revisions and modifications. developments in energy goals, market dynamics, and budgetary concerns may all have an impact on these developments. It is critical to stay up to speed on the newest legislation and engage with tax experts or professionals to maintain compliance and optimize the benefits of accelerated depreciation.

C. CASES OF STUDY

C.1 INDEX CASES

For the analysis of the given situations and possible futures, a series of cases has been created based on different details estimating data from year 0 to year 10.

As a main differentiation has been considered the obligation to achieve the reliability target. This point separates us between cases 1-4 and cases 1A-4A & 4B.

For each case, we have specified what differentiates them from each other, differentiating between the years in which they occur. [45]

C.2 CASE 1: EXISTING MAIN GRID (BASE CASE - DO NOTHING)

Year 1-10

TP (Tata power) operates & maintains only the main grid at existing cost. No additional development

C.3 CASE 2: IMPROVE MAIN GRID (FOR IMPROVED RELIABILITY)

Year 1

TP invests in equipment such as new poles, lines and fault detectors for improving the main grid lines. The reliability improves to 70% from . Demand grows at the rate of 3% every year.

Year 2-10

TP operates and maintains the improved main grid lines.

C.4 CASE 3: LOCAL GENERATION ONLY (DISCONNECT THE MAIN GRID)

Year 1

TP disconnects main grid from the cluster completely and invests in building a new generation station to cater all the demand of cluster with a reliability of 80%. Assume demand growth of 4% for each year. All the households which were previously not connected are now connected to get power supply.

Year 2 -10

TP maintains the new microgrid only.

C.5 CASE 4: EXISTING MAIN GRID + LOCAL GENERATION (FOR IMPROVED RELIABILITY)

Year 1

TP maintains existing grid and builds new local generation to improve the overall reliability to 90%. Assume the demand grows 5% every year. Assume all the households including the disconnected ones are now connected.

Year 2-10

TP maintains both the existing main grid and the local generating station.

C.6 CASE 1A: ENFORCED RELIABILITY TARGET + DO NOTHING

Year 1

TP operates & maintains only the main grid at existing cost. No additional development. OERC enforces reliability target of 80%. Penalty gets applied.

Year 2-10

TP operates & maintains only the main grid at existing cost. No additional development. Penalty gets applied.

C.7 CASE 2A: ENFORCED RELIABILITY TARGET + IMPROVE MAIN GRID

Year 1

TP operates & maintains only the main grid at existing cost. No additional development. OERC enforces reliability target of 80%. Penalty gets applied.

Year 2

OERC finances project to improve the main grid lines by providing equipment such as new poles, lines and fault detectors. The reliability improves to 70%. Demand grows at the rate of 3% every year. Penalty is applied for difference in the new and the target reliability.

Year 3-10

TP operates and maintains the improved main grid lines. Penalty is applied for difference in the new and the target reliability.

C.8 CASE 3A: ENFORCED RELIABILITY TARGET + LOCAL GENERATION

Year 1

TP operates & maintains only the main grid at existing cost. No additional development. OERC enforces reliability target of 80%. Penalty gets applied.

Year 2-10

OERC finances project to install local generator. TP disconnects main grid from the cluster completely and cater all the demand of cluster with a reliability of 80% using new generation station. Assume demand growth of 4% for each year. All the households which were previously not connected are now connected to get power supply.

Year 3-10

TP operates and maintains the new local microgrid only. No penalty or incentives as the target reliability is met

C.9 CASE 4A: ENFORCED RELIABILITY TARGET + LOCAL GENERATION + IMPROVE MAIN GRID

Year 1

TP operates & maintains only the main grid at existing cost. No additional development. OERC enforces reliability target of 80%. Penalty gets applied.

Year 2

OERC finances project to install local generator and project to improve the main grid lines by providing equipment such as new poles, lines and fault detectors. Reliability improves to 95%. Assume the demand grows 8% every year.

Year 3-10

TP maintains both the existing main grid and the local generating station. Incentives are applied to the difference between the target and new reliability.

C.10 CASE Z / CASE PLUS ULTRA:

This case is remained unfilled for trying different scenarios.

D. INVENTORY

Table 4 Inventory feeding the model

Title	Info Life	Investment/cost (€)	KW
Solar PV	25-30 years	4951,00	0,25
Batteries	5-10 years	3488,00	1,38
Diesel Generators	15-20 years	155,00	
ACDC converters	10-15 years	4900,00	11,40
Charge convereters	15 years	188,00	4,13

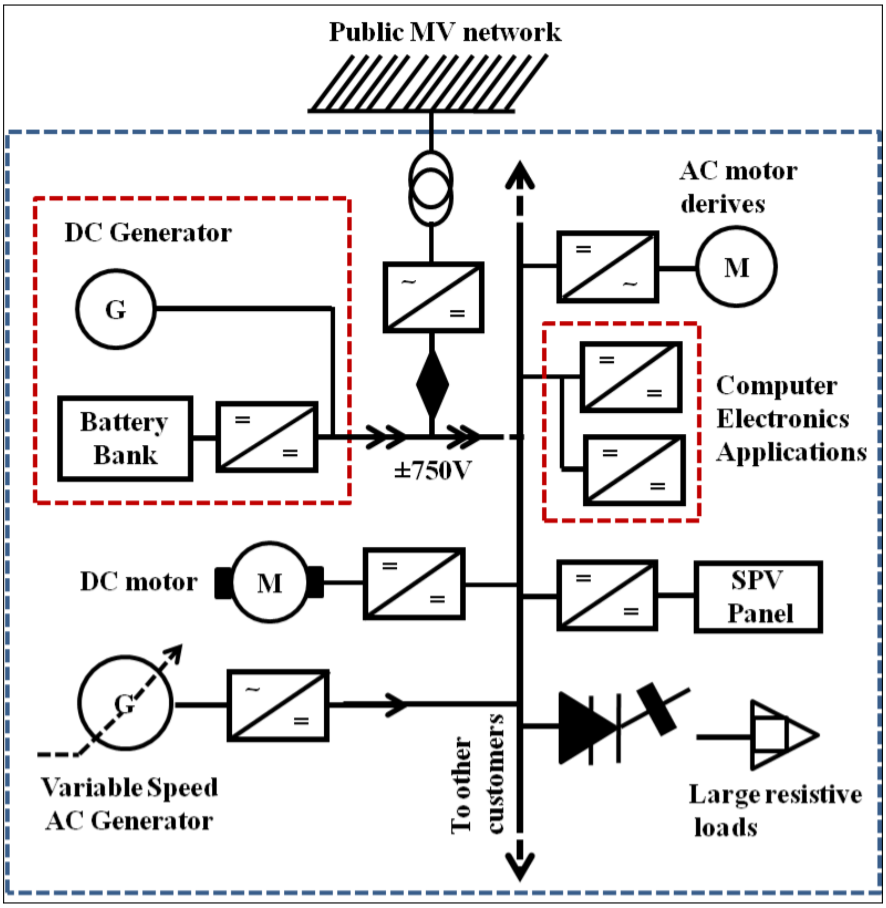

Figure 9 DC Power Distribution System for Rural Applications

D.1 MAIN GRID

The main grid is the centralized electrical power distribution network that provides electricity to customers. It comprises of power plants, transmission lines, substations, and distribution networks. The main grid is normally operated and maintained by utility corporations or government agencies and supplies dependable and uninterrupted energy to residential, commercial, and industrial consumers.

D.2 SOLAR PV

Solar PV (Photovoltaic) refers to the technique that uses solar panels to convert sunlight directly into energy. Solar PV systems are made up of photovoltaic cells that produce electrical energy when exposed to sunshine. Solar PV is a renewable energy source that is gaining popularity owing to its environmental advantages and lower prices. Solar PV systems, which may be deployed on roofs, in open areas, or integrated into buildings, provide sustainable energy for both on-grid and off-grid applications.

D.3 BATTERIES

Batteries are energy storage devices that allow electrical energy to be stored for later use. Batteries play an important role in power networks by storing extra electricity generated by renewable sources such as solar or wind power during periods of low demand. When demand is strong or a renewable energy source is unavailable, this stored energy can be released. Lithium-ion, lead-acid, and flow batteries are typical battery technologies.

D.4 DIESEL GENERATORS

Diesel generators are backup power sources that generate energy by burning diesel fuel. They are widely utilized in locations where the main grid is unstable or unavailable, as emergency power supply, or in situations when a temporary power source is necessary. Diesel generators use internal combustion engines to power electrical generators, which generate electricity. While they provide a consistent supply of electricity, they are related with carbon emissions and noise pollution.

Figure 10 Back up diesel generator

D.5 ACDC CONVERTERS

ACDC converters are devices that convert alternating current (AC) to direct current (DC). They are used in a variety of applications that demand DC power, including as electronic gadgets, battery charging systems, and renewable energy systems. ACDC converters can be built with a variety of topologies and technologies, such as diode rectifiers, thyristor-based rectifiers, or solid-state electronics.

Charge converters

Charge converters, also known as power converters or inverters, are devices that convert direct current (DC) to alternating current (AC). They are often used in solar PV systems and battery storage systems to convert the direct current (DC) power generated or stored into alternating current (AC) electricity that can be utilized by appliances and linked to the main grid. Charge converters are required to integrate renewable energy sources into the conventional AC power infrastructure [45], [46].

E. MODELING

E.1 FINANCIAL STATEMENT

E.2 PROFIT AND LOSS STATEMENT P&L

E.2.1.1 *Revenues*

This includes the revenue gained by the selling of power to customers. [38]

$$Revenue = ((Trate * 0.46) + (Trate_r * 0.54) * Tusage * Collection\ efficiency$$

- Trate→ Tarrif rate
- Trater à Tarrif rate residential
- Tusage→ Total usage (Kwh)

E.2.1.2 *COGS*

In the case of an electrical business, this category would comprise the expenditures involved with the development, operation, and maintenance of the energy supply network. This would include fuel expenses, generator maintenance, transformer maintenance, supply network costs, and electricity acquisition prices.

$$COGS = Fuel + Main\ Grid\ O\&M\ Cost\ [TPO\ proyect] + Local\ Grid\ O\&M\ Cost$$

E.2.1.3 *Gross profit*

This is calculated by subtracting the COGS from the revenue. It represents the profitability before considering operating expenses.

$$Gross\ profit = Revenue - COGS$$

E.2.1.4 ***Operating expenses***

Operating expenses include a variety of costs necessary for the day-to-day running of the business, such as staff salaries and benefits, office rent, marketing and advertising expenses, administrative expenses, utilities, insurance, among others.

In this model these costs have been determined to be zero

E.2.1.5 ***EBITDA***

Earnings Before Interest, Taxes, Depreciation, and Amortization is a measure of profitability that excludes the effects of interest, taxes, depreciation, and amortization.

It is calculated by subtracting operating expenses and non-operating costs from the Gross Profit.

E.2.1.6 ***D&A***

Depreciation and Amortization refers to the recognition of the gradual loss of value of assets specific to the grid infrastructure. Depreciation accounts for the reduction in value of tangible assets like transmission lines, substations, transformers, and control systems over their estimated useful lives. Amortization, on the other hand, represents the allocation of costs associated with intangible assets such as licenses, permits, and rights-of-way over their estimated useful lives.

E.2.1.7 ***EBIT***

Earnings Before Interest and Taxes is a financial metric that measures a company's operational profit before interest and taxes. It reveals the profitability of the company's core operations, disregarding the influence of financing and tax requirements.

E.2.1.8 ***Financial Expenses***

This includes expenses related to the company's financing, such as interest on loans and debts, it is at this point that the type of leverage realised is applied.

EBT

Earnings Before Taxes is calculated by subtracting financial expenses from the EBITDA. It represents the company's earnings before taxes.

Corporate Tax

These are the taxes that the company must pay on its earnings. The corporate tax rate for electricity companies in India is 25% plus an education and health cess of 4%, resulting in an effective tax rate of 26%.

Net Income

It is calculated by subtracting corporate taxes from the EBT. It represents the net profit of the company after taxes.

Dividends

A dividend is the distribution of a company's earnings to its shareholders. Dividends may be paid out as cash or in the form of reinvestment in additional stock.

In this model dividends have been determined to be zero

E.3 BALANCE SHEET

Cash and banks

This reflects the cash and cash equivalents held by the firm in bank accounts.

Trade receivables/Clients

It is assumed zero as trade receivables.

Inventory

It reflects the supplies and materials required in the company's activities, such as transformer spares, fuel, cables, and so on.

Net fixed assets

It is assumed zero as net fixed assets.

Total assets

It is the sum of all the company's assets, including fixed assets, accounts receivable, cash, and other assets.

Trade accounts payable/suppliers

It is assumed zero as trade accounts payable/suppliers.

Accrued expenses.

It is assumed zero as accrued expenses.

E.3.1.1 ***Tax payable***

Tax payable refers to the amount of taxes that a company owes to the government based on its taxable income. It represents the company's current tax liability, which is the amount of tax that is due and payable within the current accounting period.

The Indian legislation imposes a maximum carry-forward period of 8 years, we have assumed 10 years, crudely, to analyse in full our working period of the model.

Equity

It is assumed zero as equity.

E.3.1.2 ***Retained earnings.***

$$RE_{cy} = NI_{cy} - D + RE_{py}$$

RE_{cy}→Retained earnings current year

NI_{cy}→Net income of the current year

D→Dividends

RE_{pv}→Retained earnings of the previous year

E.4 CASH FLOW

- Direct method

Instead of converting the operational section from accrual accounting to cash accounting, the statement of cash flows direct method employs real cash inflows and outflows from the company's activities. Accrual accounting records income when it is earned rather than when it is received from a client.

- Indirect method

The indirect method changes the operational part of the cash flow statement from the accrual method to the cash method of accounting by increasing and decreasing balance sheet line items.

- EBITDA method

The EBITDA method of estimating cash flow begins with the company's EBITDA and proceeds to adjust to get at the net cash flow. The EBITDA technique gives a measure of the cash created or utilized by the firm from its core activities by adding back non-cash expenses such as depreciation and amortization, adjusting for changes in working capital, subtracting capital expenditures, and taking taxes into account. It provides insights into the company's cash flow that are independent of financing and tax variables, making it beneficial for analyzing a business's operational cash-generating capabilities.

E.5 NET PRESENT VALUE NPV

DCF

DCF is an abbreviation for Discounted Cash Flow, a financial valuation approach that is used to evaluate the value of an investment or project by discounting its future cash flows to present value. DCF considers the time value of money, since a dollar received in the future is worth less than a dollar obtained today.

NPV

The net present value (NPV) considers the time worth of money and may be used to evaluate the rates of return of different projects or to compare a predicted rate of return with the hurdle rate necessary to authorize an investment.

The discount rate, which may be a hurdle rate for a project depending on a company's cost of capital, represents the time value of money in the NPV formula. A negative NPV, regardless of how the discount rate is calculated, indicates that the projected rate of return will fall short of it, implying that the investment will not produce value.

$$NPV = \sum_{t=0}^{n} \frac{R_t}{(1+i)^t}$$

Rt → Net cash inflow-outflows during a single period t

i → Discount rate that could be earned in alternative investments, it is given by the leverage id chosen

.t → Number of time periods. It is annually and the period is 10 years so t=10.

F. RESULTS

The net present value (NPV) analysis is used to determine the feasibility of various projects or initiatives inside a corporation. If the NPV is positive, the project is likely to create positive net cash inflows. The NPV is calculated by the predicted cash flows and discounting them to their present value. For ease of reading, a table with the NPV has been developed. The following table shows the NPV calculations following the results obtained from the Cash Flow following *EBITDA* method. The columns show the types of cases, previously discussed in the chapter" Cases of study", while the rows correspond to the type of leverage used, previously explained in the" Index of financial lever".

NPV (Millions €)		Type of case							
		1	2	3	4	1A	2A	3A	4A
Type of Leverage	1	1,8091	1,6653	8,7393	9,2389	1,8091	1,8907	8,6723	9,2180
	2	1,5621	1,4279	7,7169	8,1635	1,5621	1,5694	7,6569	8,1422
	3	1,0636	0,9481	5,6976	6,0418	1,0636	1,0636	5,6512	6,0204
	4	1,3446	1,2186	6,8280	7,2290	1,3446	1,3617	6,7740	7,2076
	5	1,2454	1,1232	6,4265	6,8072	1,2454	1,2543	6,3752	6,7857
	6	0,8262	0,7192	4,7610	5,0591	0,8262	0,8620	4,7208	5,0379

1	Non-refundable financing
2	Non-profit and non-interest bearing financing
3	Fixed-rate financing
4	Financing through crowdfunding
5	Financing through green bonds
6	Financing through social venture capital

1	Existing Main Grid (Base Case - Do nothing)
2	Improve Main Grid (for improved reliability)
3	Local generation only (disconnect the main grid)
4	Existing Main Grid + Local generation (for improved reliability)
1A	Enforced reliability target + Do nothing
2A	Enforced reliability target + Improve Main Grid
3A	Enforced reliability target + Local generation
4A	Enforced reliability target + Local generation + Improve Main Grid

Comparatively, the order of leverage is more unfavourable as you move up the numerical value of interest per the money received. Thus, it is more appropriate for shareholders to receive a non-repayable amount of money in point 1 than to have to pay it back with interest, whether it is lover, as in point 2, or higher, as in point 6. Looking into the different cases, looking only at the values of one row at each time, we observe that case 4 followed by case

4A are the ones that would be giving us the highest economic return, which are the one which combined main grid alongside the local grid.

Type of financial leverage:

1. Non-refundable financing
2. Non-profit and non-interest-bearing financing.
3. Fixed-rate financing
4. Financing through crowdfunding
5. Financing through green bonds
6. Financing through social venture capital

Type of cases:

1	Existing Main Grid (Base Case - Do nothing)
2	Improve Main Grid (for improved reliability)
3	Local generation only (disconnect the main grid)
4	Existing Main Grid + Local generation (for improved reliability)
1A	Enforced reliability target + Do nothing
2A	Enforced reliability target + Improve Main Grid
3A	Enforced reliability target + Local generation.
4A	Enforced reliability target + Local generation + Improve Main Grid

After looking at the results and analysing the NPV, we can also have in consideration the results obtain in the P&L and in the Balance sheet of the financial analysis.

In the profit and loss (P&L) statement is important to take in consideration the revenue trend, thus a sustained revenue growth may indicate the company's ability to generate sales and maintain or increase its market share, which in this case is imposed by the grow of the market, this is why cases 4 with a greater demand are a bet option.

As well a stable or growing gross profit margin may indicate efficient cost management and a competitive advantage in terms of production or service delivery, not having shortages or any other kind of incident that may stop the production.

About the balance sheet is important to check the liquidity as the cashflows are the one which are paying the leverage or any complication in the grid, either local or main. The availability of cash and cash equivalents can indicate the company's ability to meet its short-term obligations and finance its day-to-day operations.

Investments in fixed assets, such as property and equipment, indicate a long-term commitment and an expectation of future growth. And a healthy net worth may suggest the company's ability to withstand financial adversity and finance future expansions or projects.

G. CONCLUSIONS

Based on the comprehensive financial statement analysis, it can be concluded that the mini-grid project in India exhibits sound financial performance and holds potential for further expansion. However, the low purchasing power in rural areas, and the low price and low power consumption compared to the high costs of implementing mini-grids, make the project difficult to realise if the appropriate leverage is not achieved. The situation should continue to be monitored for possible changes that allow for a successful long-term viable strategic planning.

The project could leverage its financial capabilities to attract more investments and obtain partnerships to extend its operations and geographical coverage. The total cost of the project may be significantly impacted by the interest rates on the bonds or loans used to secure it. Project viability increases as funding costs decrease. The capital costs associated with building the facility are also essential in establishing the profitability of the project. These costs cover issues like the price of acquiring the land, constructing the plant, and setting up the machinery.

The project's environmental and social effects may also have an impact on its profitability. The plant can encounter opposition or regulatory obstacles if it has a detrimental effect on the environment or neighboring communities. The cost of electricity plays a significant role in determining how profitable it is. It could be difficult to make enough funds to cover the grid running expenses if energy prices are low. Alternatively, if power costs are higher, the plant's profitability could rise, but it is important to consider the danger of reduced demand, growing competition and price volatility as well.

Stakeholders can utilize the insights to align their strategies and actions with the project's financial goals and contribute to the sustainable development of the mini-grid sector in India. An electric plant's competitiveness can be significantly impacted by governmental policies and regulations. For instance, subsidies and incentives for renewable energy can lower the cost of producing power from renewable sources. Furthermore, the possibility that supranational financial support—like that from the World Bank—could impact financing prices in a pertinent manner.

The creation of a financial statement analysis

Conducting a financial statement analysis is essential to gain a comprehensive understanding of the minigrids project's financial health. It enables stakeholders to assess the project's financial performance, profitability, and overall stability. By analysing balance sheet, and cash flow statement, decision-makers can make informed judgments and take appropriate actions to improve the project's financial position.

Identification of the sensitivities or leverages used.

Evaluating sensitivities or leverages employed in the minigrids project is critical for risk management and decision-making. The importance of financing in the outcome of the NPV is clear. Analyzing the project's financial accounts allows you to identify the major variables or elements that have a substantial influence on the project's financial performance. Likewise, the rate of interest is reflected in the P&L on the financial expenses breakdown.

Explanation and enhancement of minigrids using the model in real-world situations.

The demographic, geographic, meteorological, and economic problems that the Indian subcontinent is facing regarding the power grid are evident throughout the work. The mini grids allow with their great flexibility to be adaptive to converge in the best possible solution on each case. Long distances and external influences on the grid infrastructure are also avoided by making use of mini grids, thus being a great solution.

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ANEX MODEL

Direct method

€ Cash flow		Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
(+) from revenues		**82.480,6**	**83.305,4**	**84.138,5**	**84.979,8**	**85.829,6**	**86.687,9**	**87.554,8**	**88.430,4**	**89.314,7**	**90.207,8**
(-) from purchase inventory		11.354,5	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2
(-) from Opex payments		--	--	--	--	--	--	--	--	--	2.827,0
(-) from CAPEX		103.673,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5
(-) from Tax		(405.970,4)	415.137,6	(216,3)	(218,5)	(220,7)	(222,9)	(225,1)	(227,4)	(229,7)	503,1
Free cash flow		**(208.461,9)**	**617.004,6**	**202.483,8**	**203.323,0**	**204.170,6**	**205.026,7**	**205.891,4**	**206.764,7**	**207.646,7**	**212.099,5**
(-) from interest		1.597.506,8	--	--	--	--	--	--	--	--	--
(+/-) from debt		--	--	--	--	--	--	--	--	--	--
(-) from dividends		--	--	--	--	--	--	--	--	--	--
(+/-) from equity		--	--	--	--	--	--	--	--	--	--
Net cash	1	**1.389.044,9**	**617.004,6**	**202.483,8**	**203.323,0**	**204.170,6**	**205.026,7**	**205.891,4**	**206.764,7**	**207.646,7**	**212.099,5**

Indirect method

€ Cash flow		Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
(+/-) change in retained earnings		1.155.455,0	(26.089,6)	(25.473,2)	(24.850,6)	(24.221,7)	(23.586,6)	(22.945,1)	(22.297,2)	(21.642,8)	(23.073,8)
(+/-) change in equity		--	--	--	--	--	--	--	--	--	--
(+/-) change in debt		--	--	--	--	--	--	--	--	--	--
(+/-) change in tax payable		-405.970,7	415.137,3	-216,6	-218,8	-220,9	-223,2	-225,4	-227,6	-229,9	502,8
(+/-) change in accrued expenses		--	--	--	--	--	--	--	--	--	--
(+/-) change in payables		--	--	--	--	--	--	--	--	--	--
(+/-) change in receivables		--	--	--	--	--	--	--	--	--	--
(+/-) change in inventory		(706,8)	--	--	--	--	--	--	--	--	--
(+/-) change in net fixed assets		(2.827,0)	--	--	--	--	--	--	--	--	--
Net cash	2	**745.950,6**	**389.047,7**	**(25.689,8)**	**(25.069,3)**	**(24.442,7)**	**(23.809,7)**	**(23.170,5)**	**(22.524,8)**	**(21.872,7)**	**(22.571,0)**

EBITDA method

€ Cash flow		Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
EBITDA		**70.419,4**	**71.244,2**	**72.077,2**	**72.918,6**	**73.768,4**	**74.626,7**	**75.493,6**	**76.369,1**	**77.253,4**	**75.319,6**
(+/-) change in receivables		--	--	--	--	--	--	--	--	--	--
(+/-) change in inventory		(706,8)	--	--	--	--	--	--	--	--	--
(+/-) change in payables		--	--	--	--	--	--	--	--	--	--
(+/-) change in accrued expenses		--	--	--	--	--	--	--	--	--	--
(-) from CAPEX		103.673,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5
(-) from Tax		(405.970,4)	415.137,6	(216,3)	(218,5)	(220,7)	(222,9)	(225,1)	(227,4)	(229,7)	503,1
Free cash Flow		**(232.584,3)**	**592.882,2**	**178.361,3**	**179.200,6**	**180.048,2**	**180.904,3**	**181.768,9**	**182.642,2**	**183.524,2**	**182.323,1**
(+/-) from interest		1.597.506,8	--	--	--	--	--	--	--	--	--
(+/-) from debt		--	--	--	--	--	--	--	--	--	--
(-) from dividends		--	--	--	--	--	--	--	--	--	--
(+/-) from equity		--	--	--	--	--	--	--	--	--	--
Net cash	3	**1.364.922,4**	**592.882,2**	**178.361,3**	**179.200,6**	**180.048,2**	**180.904,3**	**181.768,9**	**182.642,2**	**183.524,2**	**182.323,1**

P&L		Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
Revenues		82.480,6	83.305,4	84.138,5	84.979,8	85.829,6	86.687,9	87.554,8	88.430,4	89.314,7	90.207,8
COGS		12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2
Gross profit		**70.419,4**	**71.244,2**	**72.077,2**	**72.918,6**	**73.768,4**	**74.626,7**	**75.493,6**	**76.369,1**	**77.253,4**	**78.146,6**
Operating expenses		--	--	--	--	--	--	--	--	--	2.827,0
EBITDA		**70.419,4**	**71.244,2**	**72.077,2**	**72.918,6**	**73.768,4**	**74.626,7**	**75.493,6**	**76.369,1**	**77.253,4**	**75.319,6**
D&A		106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5
EBIT		**(36.081,1)**	**(35.256,3)**	**(34.423,2)**	**(33.581,8)**	**(32.732,0)**	**(31.873,7)**	**(31.006,9)**	**(30.131,3)**	**(29.247,0)**	**(31.180,9)**
Financial Expenses		1.597.506,8	--	--	--	--	--	--	--	--	--
EBT		**1.561.425,7**	**(35.256,3)**	**(34.423,2)**	**(33.581,8)**	**(32.732,0)**	**(31.873,7)**	**(31.006,9)**	**(30.131,3)**	**(29.247,0)**	**(31.180,9)**
Corporate Tax	26,0%	26,0%	26,0%	26,0%	26,0%	26,0%	26,0%	26,0%	26,0%	26,0%	26,0%
Net Income		**1.155.455,0**	**(26.089,6)**	**(25.473,2)**	**(24.850,6)**	**(24.221,7)**	**(23.586,6)**	**(22.945,1)**	**(22.297,2)**	**(21.642,8)**	**(23.073,8)**
Dividends		--	--	--	--	--	--	--	--	--	--

Balance sheet		Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
Cash and banks	0	1.364.922,4	1.957.804,6	2.136.165,9	2.315.366,5	2.495.414,7	2.676.318,9	2.858.087,8	3.040.730,0	3.224.254,3	3.406.577,4
Trade receivables/Clients	0	--	--	--	--	--	--	--	--	--	--
Inventory	0	706,8	706,8	706,8	706,8	706,8	706,8	706,8	706,8	706,8	706,8
Net fixed assets		2.827,0	2.827,0	2.827,0	2.827,0	2.827,0	2.827,0	2.827,0	2.827,0	2.827,0	2.827,0
Total assets		**1.368.456,2**	**1.961.338,3**	**2.139.699,7**	**2.318.900,2**	**2.498.948,4**	**2.679.852,7**	**2.861.621,6**	**3.044.263,8**	**3.227.788,0**	**3.410.111,1**
Trade accounts payable/suppliers	0	0	0	0	0	0	0	0	0	0	0
Accrued expenses		--	--	--	--	--	--	--	--	--	--
Tax payable		(405.970,7)	9.166,6	8.950,0	8.731,3	8.510,3	8.287,2	8.061,8	7.834,1	7.604,2	8.107,0
Debt		--	--	--	--	--	--	--	--	--	--
Equity		--	--	--	--	--	--	--	--	--	--
Retained earnings		1.155.455,0	1.129.365,3	1.103.892,2	1.079.041,6	1.054.819,9	1.031.233,3	1.008.288,2	985.991,1	964.348,3	941.274,4
Total shareholers equity & liabilities		**749.484,3**	**1.138.532,0**	**1.112.842,2**	**1.087.772,9**	**1.063.330,2**	**1.039.520,5**	**1.016.350,0**	**993.825,2**	**971.952,5**	**949.381,5**

	Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Capital Cost	Grid Capital Cost	3195014	0	0	0	0	0	0	0	0	0	0
	Solar PV	0	0	0	0	0	0	0	0	0	0	0
	Batteries	0	0	0	0	0	0	0	0	0	0	0
	ACDC converters	0	0	0	0	0	0	0	0	0	0	0
	Charge convereters	0	0	0	0	0	0	0	0	0	0	0
	Diesel Generators	0	0	0	0	0	0	0	0	0	0	0
	Total Capital Cost	3195014	0	0	0	0	0	0	0	0	0	0
Depreciation	Main Grid Components	106500	106500	106500	106500	106500	106500	106500	106500	106500	106500	106500
	Solar PV (25 years)	0	0	0	0	0	0	0	0	0	0	0
	Batteries (10 years)	0	0	0	0	0	0	0	0	0	0	0
	ACDC converters (15 years)	0	0	0	0	0	0	0	0	0	0	0
	Charge convereters (15 years)	0	0	0	0	0	0	0	0	0	0	0
	Diesel Generators	0	0	0	0	0	0	0	0	0	0	0
	Total Depreciation	106500	106500	106500	106500	106500	106500	106500	106500	106500	106500	106500
Annual Cost	Main Grid O&M Cost [TPO proyect]	2827	2827	2827	2827	2827	2827	2827	2827	2827	2827	2827
	Local Grid O&M Cost	0	0	0	0	0	0	0	0	0	0	0
	Grid purchase Cost	0	0	0	0	0	0	0	0	0	0	0
	Total Annual Cost	2827	2827	2827	2827	2827	2827	2827	2827	2827	2827	2827
Revenue	Total Revenue	82481	83305	84138	84980	85830	86688	87555	88430	89315	90208	91110

Salvage Value	Market Value (PV)	3088513	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500

NPV	377420965

	Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Capital Cost	Grid Capital Cost	3195014	0	0	0	0	0	0	0	0	0	0
	Solar PV	1782	0	0	0	0	0	0	0	0	0	0
	Batteries	3666600	0	0	0	0	0	0	0	0	0	0
	ACDC converters	57198	0	0	0	0	0	0	0	0	0	0
	Charge convereters	161798	0	0	0	0	0	0	0	0	0	0
	Diesel Generators	1000	0	0	0	0	0	0	0	0	0	0
	Total Capital Cost	7083392	0	0	0	0	0	0	0	0	0	0
Depreciation	Main Grid Components	106500	106500	106500	106500	106500	106500	106500	106500	106500	106500	106500
	Solar PV (25 years)	71	71	71	71	71	71	71	71	71	71	71
	Batteries (10 years)	611100	611100	611100	611100	611100	611100	611100	611100	611100	611100	611100
	ACDC converters (15 years)	3813	3813	3813	3813	3813	3813	3813	3813	3813	3813	3813
	Charge convereters (15 years)	10787	10787	10787	10787	10787	10787	10787	10787	10787	10787	10787
	Diesel Generators	67	67	67	67	67	67	67	67	67	67	67
	Total Depreciation	732338	732338	732338	732338	732338	732338	732338	732338	732338	732338	732338
Annual Cost	Main Grid O&M Cost [TPO proyect]	0	0	0	0	0	0	0	0	0	0	0
	Local Grid O&M Cost	23948	23948	23948	23948	23948	23948	23948	23948	23948	23948	23948
	Grid purchase Cost	0	0	0	0	0	0	0	0	0	0	0
	Total Annual Cost	23948	23948	23948	23948	23948	23948	23948	23948	23948	23948	23948
Revenue	Total Revenue	147421	148896	150385	151889	157964	164283	170854	177688	184796	192187	199875
Salvage Value	Market Value (PV)	3088513	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500
NPV		6827962										

Tipo de caso	Leverage id
3	4

Curecies ratio	Factores conversión	
USD/USD	1	
USD/EUR	0,915	Informacion del tipo de cambio a 16/05/23
INR/EUR	0,011	
INR/USD	0,012	

taxes apply DCF	26%

	Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Capital Cost	Grid Capital Cost	3195014	0	0	0	0	0	0	0	0	0	0
	Solar PV	1782	0	0	0	0	0	0	0	0	0	0
	Batteries	3666600	0	0	0	0	0	0	0	0	0	0
	ACDC converters	57198	0	0	0	0	0	0	0	0	0	0
	Charge convereters	161798	0	0	0	0	0	0	0	0	0	0
	Diesel Generators	1000	0	0	0	0	0	0	0	0	0	0
	Total Capital Cost	7083392	0	0	0	0	0	0	0	0	0	0
Depreciation	Main Grid Components	106500	106500	106500	106500	106500	106500	106500	106500	106500	106500	106500
	Solar PV (25 years)	71	71	71	71	71	71	71	71	71	71	71
	Batteries (10 years)	611100	611100	611100	611100	611100	611100	611100	611100	611100	611100	611100
	ACDC converters (15 years)	3813	3813	3813	3813	3813	3813	3813	3813	3813	3813	3813
	Charge convereters (15 years)	10787	10787	10787	10787	10787	10787	10787	10787	10787	10787	10787
	Diesel Generators	67	67	67	67	67	67	67	67	67	67	67
	Total Depreciation	732338	732338	732338	732338	732338	732338	732338	732338	732338	732338	732338
Annual Cost	Main Grid O&M Cost [TPO proyect]	0	0	0	0	0	0	0	0	0	0	0
	Local Grid O&M Cost	23948	23948	23948	23948	23948	23948	23948	23948	23948	23948	23948
	Grid purchase Cost	0	0	0	0	0	0	0	0	0	0	0
	Total Annual Cost	23948	23948	23948	23948	23948	23948	23948	23948	23948	23948	23948
Revenue	Total Revenue	147421	148896	150385	151889	157964	164283	170854	177688	184796	192187	199875
Salvage Value	Market Value (PV)	3088513	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500

NPV	4760977

Tipo de caso	Leverage id
3	6

Currecies ratio	Factores conversión	
USD/USD	1	
USD/EUR	0,915	Informacion del tipo de cambio a 16/05/23
INR/EUR	0,011	
INR/USD	0,012	

taxes apply DCF	26%

	Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Capital Cost	Grid Capital Cost	3195014	0	0	0	0	0	0	0	0	0	0
	Solar PV	1782	0	0	0	0	0	0	0	0	0	0
	Batteries	3666600	0	0	0	0	0	0	0	0	0	0
	ACDC converters	57198	0	0	0	0	0	0	0	0	0	0
	Charge convereters	161798	0	0	0	0	0	0	0	0	0	0
	Diesel Generators	1000	0	0	0	0	0	0	0	0	0	0
	Total Capital Cost	7083392	0	0	0	0	0	0	0	0	0	0
Depreciation	Main Grid Components	106500	106500	106500	106500	106500	106500	106500	106500	106500	106500	106500
	Solar PV (25 years)	71	71	71	71	71	71	71	71	71	71	71
	Batteries (10 years)	611100	611100	611100	611100	611100	611100	611100	611100	611100	611100	611100
	ACDC converters (15 years)	3813	3813	3813	3813	3813	3813	3813	3813	3813	3813	3813
	Charge convereters (15 years)	10787	10787	10787	10787	10787	10787	10787	10787	10787	10787	10787
	Diesel Generators	67	67	67	67	67	67	67	67	67	67	67
	Total Depreciation	732338	732338	732338	732338	732338	732338	732338	732338	732338	732338	732338
Annual Cost	Main Grid O&M Cost [TPO proyect]	2827	2827	2827	2827	2827	2827	2827	2827	2827	2827	2827
	Local Grid O&M Cost	0	12875	12875	12875	12875	12875	12880	12880	12880	12880	12875
	Grid purchase Cost	0	49663	54142	58983	64275	70110	76310	82942	89914	97192	104866
	Total Annual Cost	2827	65365	69844	74685	79977	85812	92017	98650	105621	112899	120568
Revenue	Total Revenue	125785	179621	188602	198032	207934	218330	229247	240709	252745	265382	278651
Salvage Value	Market Value (PV)	3088513	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500	-106500
NPV		5037893										

Tipo de caso	Leverage id
4A	6

Currecies ratio	Factores conversión	
USD/USD	1	
USD/EUR	0,915	Informacion del tipo de cambio a 16/05/23
INR/EUR	0,011	
INR/USD	0,012	

taxes apply DCF	26%

Net fixed assets											
Bop		--	2.827,0	2.827,0	2.827,0	2.827,0	2.827,0	2.827,0	2.827,0	2.827,0	2.827,0
Add	*Capex*	(103.673,5)	(106.500,5)	(106.500,5)	(106.500,5)	(106.500,5)	(106.500,5)	(106.500,5)	(106.500,5)	(106.500,5)	(106.500,5)
Red	*depreciation*	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5	106.500,5
Eop		**2.827,0**	**2.827,0**	**2.827,0**	**2.827,0**	**2.827,0**	**2.827,0**	**2.827,0**	**2.827,0**	**2.827,0**	**2.827,0**
Tax payable											
Bop		--	(405.970,7)	9.166,6	8.950,0	8.731,3	8.510,3	8.287,2	8.061,8	7.834,1	7.604,2
Add	*tax PL*	(0,3)	(0,3)	(0,3)	(0,3)	(0,3)	(0,3)	(0,3)	(0,3)	(0,3)	(0,3)
Red	*cash paid*	(405.970,4)	415.137,6	(216,3)	(218,5)	(220,7)	(222,9)	(225,1)	(227,4)	(229,7)	503,1
Eop		**(405.970,7)**	**9.166,6**	**8.950,0**	**8.731,3**	**8.510,3**	**8.287,2**	**8.061,8**	**7.834,1**	**7.604,2**	**8.107,0**
Interest payable											
Bop		--	--	--	--	--	--	--	--	--	--
Add	*interest PL*	(1.597.506,8)	--	--	--	--	--	--	--	--	--
Red	*cash paid*	1.597.506,8	--	--	--	--	--	--	--	--	--
Eop		**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Debt											
Bop		--	--	--	--	--	--	--	--	--	--
Add	*cash in/out*	--	--	--	--	--	--	--	--	--	--
Red											
Eop		**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

Trade receivables/Clients											
Bop		–	–	–	–	–	–	–	–	–	–
Add	revenues	82.480,6	83.305,4	84.138,5	84.979,8	85.829,6	86.687,9	87.554,8	88.430,4	89.314,7	90.207,8
Red	cash received	(82.480,6)	(83.305,4)	(84.138,5)	(84.979,8)	(85.829,6)	(86.687,9)	(87.554,8)	(88.430,4)	(89.314,7)	(90.207,8)
Eop		–	–	–	–	–	–	–	–	–	–
Inventory											
Bop		–	706,8	706,8	706,8	706,8	706,8	706,8	706,8	706,8	706,8
Add	purchases	(11.354,5)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)
Red	cogs	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2
Eop		**706,8**	**706,8**	**706,8**	**706,8**	**706,8**	**706,8**	**706,8**	**706,8**	**706,8**	**706,8**
Trade accounts payable/suppliers											
Bop		–	–	–	–	–	–	–	–	–	–
Add	purchases	(11.354,5)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)	(12.061,2)
Red	cash paid	11.354,5	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2	12.061,2
Eop		–	–	–	–	–	–	–	–	–	–
Accrued expenses											
Bop		–	–	–	–	–	–	–	–	–	–
Add	purchases	–	–	–	–	–	–	–	–	–	(2.827,0)
Red	cash paid	–	–	–	–	–	–	–	–	–	2.827,0
Eop		–	–	–	–	–	–	–	–	–	–