Enhancing Affordable Clean Energy

SDGs No.7

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7 AFFORDABLE AND CLEAN ENERGY

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RENEWABLE
ENERGY
IS NOT REAL!

Contents

Member Introduction

: Tuan

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Mentor : Metha

Breaking down the Problem Statement

How can we **enhance access to clean and affordable energy sources** in **aging Asian cities** with **outdated infrastructure**?

Context for Southeast Asia and Japan:

Higher Electricity Bills due to spikes in base prices

For e.g., existing infrastructure and electricity bill calculations in Thailand burden end users with high electricity costs. Over the past decade, electricity prices have risen by 15%

Over Capacity of Transmission Grids

For e.g., in Indonesia, the grid operates at 90% capacity, while Thailand's grid is operating at 95% capacity, posing significant risks for stability and reliability

Increasing Electricity Demand from Population Growth

For e.g., Manila in the Philippines has experienced a 25% increase, exacerbating supply challenges

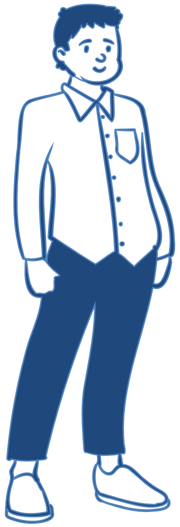
Conflict of Interest in the Industry

For e.g., in Vietnam, 40% of renewable energy projects face delays due to regulatory disagreements

Source: World Bank, 2019; Rosales, 2018, Putra et al., 2017; Asian Development Bank, 2021, (Energy Policy Institute, 2020, Le & Nguyen, 2019.

Meet Siti and Chanathip

Lower Income
Name: Siti Nurhayati
Age: 50 years old



Higher Income
Name: Chanathip Songsri
Age: 30 years old

[Persona 1]

Lower Income

Name: Siti Nurhayati (working adult)
Age: 50 years old
Lifestyle:
1. Manages household expenses on a tight budget
2. Concerned about family's quality of life and well-being
   > ensures her family's basic needs are met
   > keeps track of bills, grocery expenses, and other necessary costs

Behaviour & Actions:

Cost Consciousness
> always on the look out for ways to reduce expenditures (e.g. discounts, promotions, cost-cutting measures)

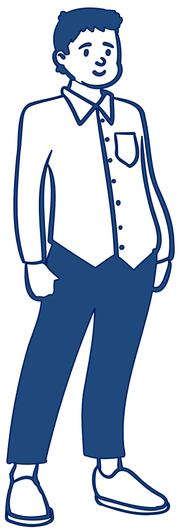
Value Seeking
> prefers products/solutions that offer best value for money
> Utilizes community resources and networks for support and savings

Pain Points:

Struggles with high energy cost and limited income

Deals with unreliable electricity supply and power outages

[Persona 2]



Higher Income

Name: Chanathip Songsri (working adult)
Age: 30 years old
Lifestyle:

1. Works in a very demanding job
2. Maintains an active social life and values convenience
   > maintains a busy schedule with friends, family, and social engagements.
   > prioritize solution that saves time, reduce effort, and integrated easily

Behaviour & Actions:

Seeks Convenience :
> prefers solutions that are easy to use and integrate seamlessly

Eco-Conscious:
> interested in sustainable practices, their energy usage and environmentally friendly solutions

Pain Points:

Skeptical regarding the ROI when investing in sustainable projects

Hard to find sustainability solutions that can easily be integrated to his lifestyle

We consolidated the key pain points and refined our problem statement, establishing guidelines and best practices to facilitate the development of renewable energy.

	1 Affordability	2 Reliability	3 Low-Carbon
Behaviour/Pain Points	• High electricity bills from fluctuations in fossil fuel prices and electricity pricing infrastructure. • Burdening Maintenance Cost	• Power Outage due to poor infrastructure and Government • Intermittency of renewable energy	• Emissions from existing infrastructure, particularly coal and fossil fuel plants, are now a global concern due to high carbon emissions.
Problem Statement	How can our solution keep electricity affordable while integrating renewable energy systems?	How can our solution ensure optimum reliability and stability of the electricity supply within the community?	How can our solution contribute to a low-carbon future?

Source:

Solution Breakdown

Coupling both community-based solar investments and grid upgrades, our solution seeks to support the energy transition, while achieving both affordability and reliability

- Holistic platform, combining both financial, environmental, and social nudges to encourage community solar investments.
- Portfolio of community solar projects could be enabled by the sale of electricity and RECs

1. Community-based Solar Projects

2. Energy Management System

3.Grid Re-conductoring

- Replacing existing transmission cables with a newer cable material: trapezoidal aluminum conductor, encapsulated carbon composite core-concentric-lay-stranded
- Grid reconductoring utilizes existing electrical supporting infrastructure (e.g., concrete, steel, and mono stobie poles)

- Setting up a network that creates a smart energy management system to manage balancing of demand and supply
- System will be connected to a consumer interface used by the residents in the community to provide visibility and transparency for upstream and downstream consumption

Bringing together urban investment into community solar towards creating new financing solutions through better applied data

"How do I make my electricity more renewable when I don't have the space for it?"

"How can I electrify my home without the funding to build power generation?"

Solution: Supported by data, we can allow urban consumer to finance and benefit from community solar projects done in available areas.

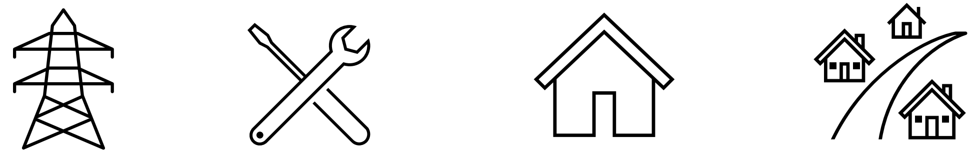
- **Community Investment:** Urban consumers can be given personalized nudges to participate in renewable investment
- **Connected Returns:** The energy paid and used by the community can be used to pay back investors

Key Drivers

Smart Data: Utilizing smart meter infrastructure, we can provide live energy insights to encourage greener behavior and investment

Flexible Financing: Hosting community based investment and pure financial transactions, we can create new pathways for investment

Partners:



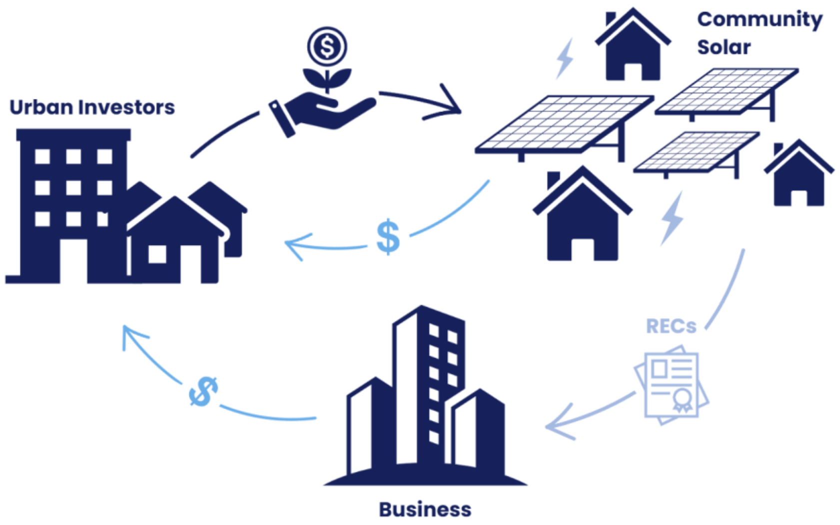
Utilities | EPCs | Households | Communities

Benefits:

- **Community Involvement :** Local communities can better participate in energy investment and become more proactive participants in the ecosystem
- **Renewable Integration :** Further integration of renewables in local community can be accelerated through improved partnerships

Solution 1: Community-based Solar Projects

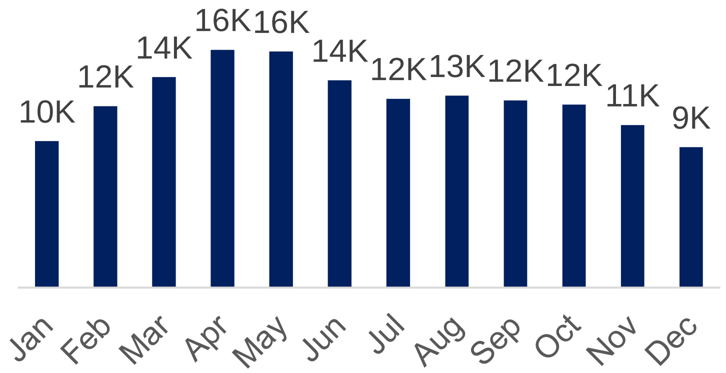
Financing of Community-based Solar projects can through a combination of electricity sales and the sale of Renewable Energy Certificates (RECs)



- **Investment Aggregation:** Energy data can be used to promote behavioral change and encourage investment in renewables
- **Dual Income Stream:** The sale of energy to the community alongside the RECs can be used to offset the investor's electricity cost
- **Sample Projection:** Sampling a 100kW community solar project, we can simulate the development of a sample system

Case Study: Calapan, Mindoro, Philippines

Monthly Energy Generation (kWh)



Key Outcomes	Unit	Output
Annual Total Generation	kWh	150,111
Annual potential cost	USD$	3,152
Net Present Value	USD$	$179,305
Internal Rate of Return	%	32.45%
Payback Period	Years	3.14

Smart energy management system bridges the gap between supply and demand and provides visibility upstream and downstream for consumers

Input/Data Source


Rooftop Solar PV Generation


Energy Data


Diesel/LNG usage


SCADA Network Operation Data


CESS Operations


Feeder Pillar


VRDT Operations

Smart Energy Management System

- Access Network Performance & DER Capacity Generation Profile
- Identify & Forecast Future DER generation & growth
- Identify the placement for smart grid enablers as fault detection
- Optimize DER generation usage

Outputs/To support

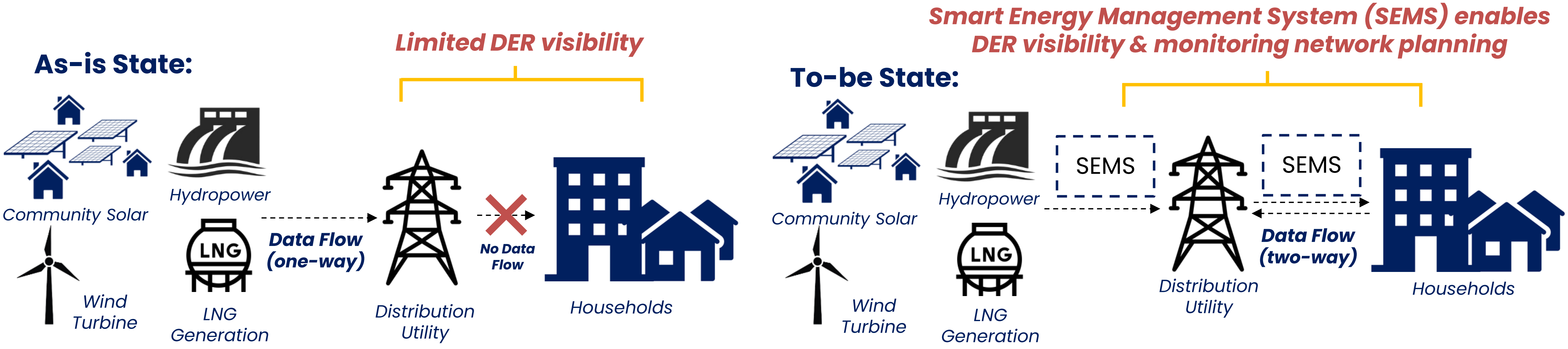

Optimization of System Planning


Control & Optimization of Network System Operation

Source: TNB Semi Project, *Benchmarking TNB's SEMI Projects in Malaysia

Bi-directional data flows between supply and demand support forecasting improve load balancing and optimises long-term operational cost

Distribution Network



Current Problem

Lack of reliability due inability to manage DER intermittency

Imbalance of load between demand and supply

Distributed Energy Resources (DER) Framework

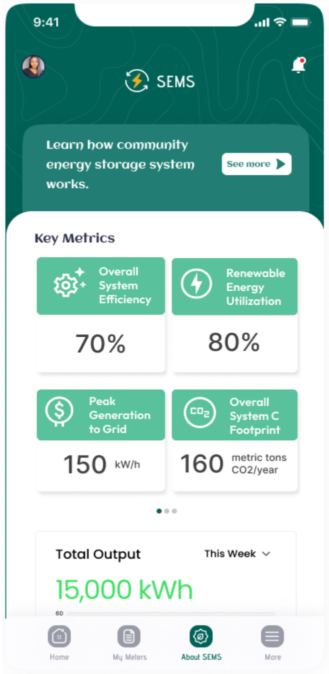
- **Consolidate all related data source** and enables centralized visibility, monitoring planning of DER assets
- Provide visibility of **real time monitoring** of load and generation within localized community/areas
- Balancing the **energy flow** (intermittency) of renewable energy sources
- Substantial **reduction in energy wastage** & maximizing of efficiency
- Actively fostering the expansion of **Renewable Energy (RE)**

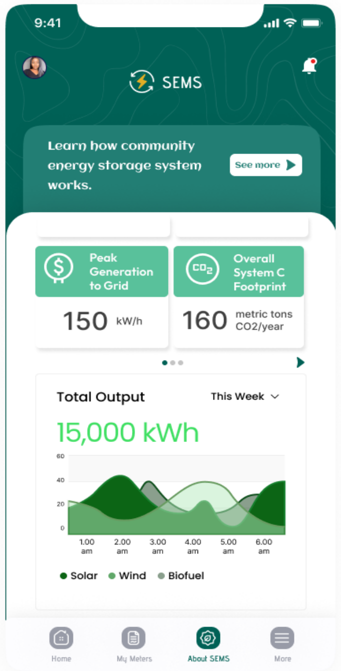
Benefits

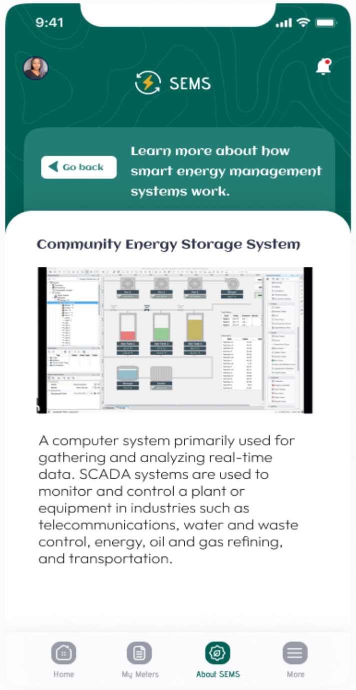
Utility Provider
- Optimizes long-term operational costs

Customer
- Visibility to enable energy consumption habit changes

Prototype: Demonstration of Smart Energy Management System Software







Grid Performance KPI

A snapshot of key metrics related to community energy storage system in a **user-friendly format** (%).

Total Energy Generation and Usage

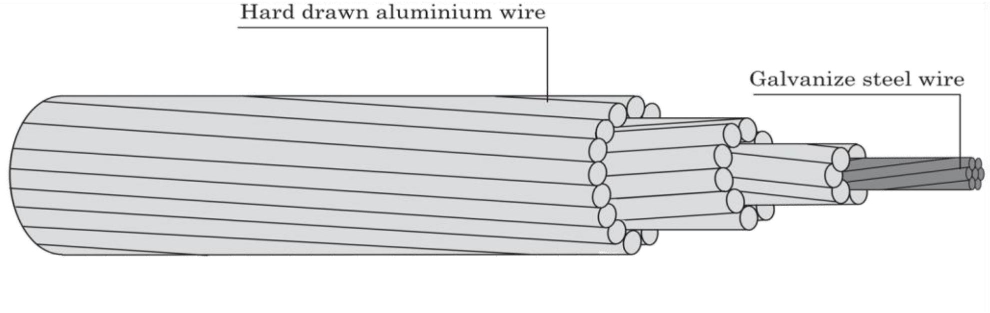
- Displays **output distribution** of different energies (solar, wind, biofuel)
- Helps users to understand **peak usage times** and performance of various grids.

Solar Community Program

- Describes the **system's function in gathering** and analysing real-time data
- Optimizes energy usage, **reduce operation costs** while ensuring reliable supply and minimizing environmental impact.

Conventional transmission cables require high cost of O&M and result in grid capacity constraints, unsuitable for widespread renewable energy integrations

Traditionally, overhead transmission cables used in Asia are largely hard drawn aluminum wires, concentric stranded conductor with steel reinforced.



Business as usual: Aluminum conductor steel reinforced (ACSR)

- Most conventional and most versatile TC to date, developed back in 1900
- Made up of galvanized steel core arranged in strands and encircled with layers of aluminum 1350-H19 wire
- Steel core provides the mechanical support while the aluminum outer layer provides the electrical conductivity

Issues faced by ACSR cables:

High cost of O&M

High-density of the steel core increases the cost of O&M of grid networks

Limited Operating Temperature

Operating temperature up to 100°C limits carrying capacity

Source: Hesterlee et al.

Solution 3: Grid Reconductoring

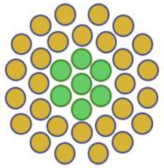
Enhancing cable conductor within Asia to increase grid capacity during peak generation and demand, enabling the integration of renewables within the grid

Solution: Using advanced conductor to replace the central steel cores with composite materials, such as carbon fiber, and replace the circular aluminium conductors with trapezoidal ones

2-3x capacity during peak generation and demand

Reduce 40-50% transmission losses during operations

- **Direct Savings:** Cutting transmission losses by 50% would reduce the amount of energy generated and purchased by retailers
- **Indirect Savings**: Increase the grid capacity enables more RE to be injected, reduce emissions (+ carbon taxes of 200 Baht/metric tonne from 2025 onwards)



As-is state: ACSR. Circular aluminium conductors, galvanized steel core.

To-be state: Advanced conductor. Trapezoidal annealed aluminium conductors, carbon fiber composite cores.

Suppliers:

CTC GLOBAL

TS CONDUCTOR Electricity delivered better.

ميدال للكابلات Midal Cables

Customers:

elia group

PLN

KEPCO

SOUTHERN CALIFORNIA EDISON

Source: CTC Global, CTC Global's ACCC Reconductoring, Thailand's Public Relations Department, Economic analysis of aluminium conductor composite core and conventional aluminium conductor steel reinforced conductors in overhead ultra-high voltage transmission lines,

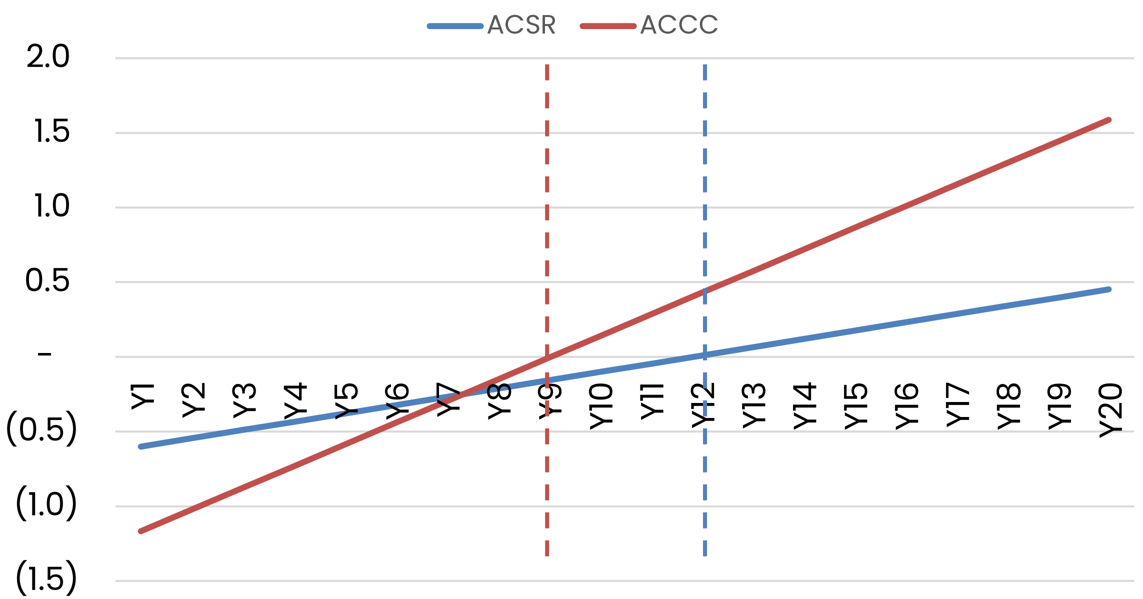
Solution 3: Grid Reconductoring

Using ACCC technology provides more favourable financials than using ACSR, especially given that Thailand is committed to ramping up renewables share (%)

Key Assumptions:

- Taking an example in Bangkok, Thailand
- Grid tariff remains constant at 4.45B/kWH, with generation costs (~50%) and transmission costs (~10%)
- Transmission losses: 6.11%, using latest available rate, dated in 2014
- All new grid capacity would be taken up by renewable energy assets, with a cost savings of 10% against BAU of LNG generation (LCOE)
- Ceteris paribus for both scenarios, except the material of conductor, with cost of ACCC being twice as much as ACSR
- Discount rate: 5.5% (average cost of debt)

Cumulative Net Loss/Gain (mUSD$)



Key Costs	Unit	ACSR	ACCC
CAPEX cost	mUSD$	(0.7)	(1.3)
Annual OPEX cost	mUSD$	(0.003)	(0.01)
Replacement cost	mUSD$	(0.003)	(0.01)
Annual Tariff revenue	mUSD$	0.059	0.061
RE New Capacity	mUSD$		0.09

Key Outcomes	Unit	ACSR	ACCC
Net Present Value	mUSD$	0.24	1.03
Internal Rate of Return	%	9	12
Payback Period	Years	11.84	9.05

Source: Thunder Said Energy, Energy Central, Bangkok Post, Global Transmission Report, Asian Power, ZAUBA ASCR Imports,

We have identified key stakeholders that would be relevant for our solutions and key enablers to accelerate the implementation

Stakeholders:

Governmental bodies: Regulation, policy-making, and incentives

Locals: Community engagement/approval and local infrastructure support

Corporations: Development and implementation of advanced material cable, development of smart EMS application

Key Enablers:

- **Policy and regulatory Framework:** Including standards, Incentive programs and public-private partnership *(e.g., feed-in tariff schemes in Vietnam)*
- **Financial mechanisms**: Civic engagement for community-based investment, nationally regulated renewable energy certification (RECs) mechanism *(e.g., PLN's TIGR platform)*
- **Technology and Innovation:** Smart grid technologies for efficient energy management and distribution *(e.g., Hitachi Energy's SCADA, Schneider Electric's Microgrid Software)*

We identified key challenges in multiple spheres and suggested potential mitigation strategies and tactics

	1 Government	2 People	3 Infrastructure
Challenges	**Creation of additional regulatory requirements on the participating government for new grid installations.**	**A lack of community awareness about renewable energy could lead to the absence of community grid development.**	**Reconductoring with advanced conductors may face terminal constraints, such as limitations in breakers, switches, protection systems, and other devices.**
Mitigation Strategy	By engaging with government stakeholders early to address concerns and ensure compliance, while also advocating for regulatory incentives to support the installation for the new grid.	By using data from existing community solar grid customers. Data will showcase the benefits of participating in the program, including average cost savings on electricity bills and reduction in carbon footprint.	By assessing existing infrastructure & identifying limitations in breakers, switches, and protection systems. Plan and budget for upgrading or replacing these components to match new conductor ratings.

Source: India's Ministry of Power

An initial study (~3 months) needs to be conducted to identify the countries we ought to be targeting, before expanding the portfolio and executing the roadmap (~30 months)

Planning and Initial Set-up

Executing the Roadmap

Monitoring & Evaluation

Planning and Initial Setup (6-9 months)

- Stakeholder Engagement and Partnerships
- Feasibility Study and Site Selection
- Launch community engagement and awareness programs

Execution (12-18 months)

- Installation of solar panels infrastructure and project commissioning
- Develop SEMS and integrate with existing infrastructure
- Replace transmission cables and conduct testing and quality assurance

Monitoring, Evaluation (3-4 months)

- Setting up continuous improvement system
- Monitor System Performance
- Impact Assessment and Evaluation

Will be repeated for every single country within the pipeline, adjusted based on local contexts

Conclusion

AFFORDABLE AND CLEAN ENERGY

	1 Affordability	2 Reliability	3 Low-Carbon
Challenges	**How can our solution keep electricity affordable while integrating renewable energy systems?**	**How can our solution ensure optimum reliability and stability of the electricity supply within the community?**	**How can our solution contribute to a low-carbon future?**
Solution	• Community-based Solar Projects • Energy Management System	• Community-based Solar Projects • Energy Management System • Grid Re-Conductoring	• Community-based Solar Projects • Grid Re-Conductoring

Source: India's Ministry of Power

RENEWABLE ENERGY IS REAL!!!!!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