Industry and Policy Perspectives, Readiness for Low-Carbon Transport

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About Us – LUMS Energy Institute

LUMS
A Not-for-Profit University

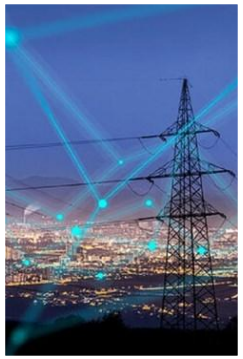
- Vision: Help the energy sector with adoption of advanced technologies for supply of affordable and sustainable energy for all
- Mission: Become a think tank, center of technical excellence, knowledge network, and capacity building ground for the nation to institutionalize a renewable rich future in the most cost-effective way possible
- Strategic Goals:

Power & Energy Planning

- ARE Policy 2019 Consultative Session
- LUMS Power Dispatch Model (LPDM)
- Grid Code Revision Activity
- Integrated System Planning Activities

Capacity Development

- Graduate Courses on Power System Planning & Electricity Markets
- Wheeling Consultative Sessions
- Power Sector Center of Excellence (PSCE)



Grid Modernization

- Energy Informatics
- Microgrids
- Energy Efficiency & Conservation
- Smart Water Heating

Adoption of RE Technologies

- EVs and Lithium-ion Battery Storage Systems
- Off-grid Solar Electrification
- Agri-photovoltaics
- Energy, Food & Transportation Nexus (EFTN)

Pakistan's solar rush unlocked $17-19bn in private investment in 8 years: study

- In FY25 alone, solar mobilised $5-6bn, emerging as one of Pakistan's strongest channels of private capital, study 'The Many Dividends of Solar Rush in Pakistan' says

Rehan Ayub Published December 12, 2025

Pakistan's great solar escape: A revolution from below

Citizen-driven innovation shows how renewable adoption can leapfrog fossil fuels

Last updated: September 17, 2025 | 16:29

Sajjad Ashraf, *Special to Gulf News*

Pakistan's solar surge lifts it into rarefied 25% club

Gavin Maguire

June 17, 2025 5:00 PM GMT+5 · Updated June 17, 2025

Pakistan surpasses G20 nations in solar imports from China

by **News Desk** — June 5, 2025 in **China-Pakistan**

Ben Payton
Thu 28th August 2025

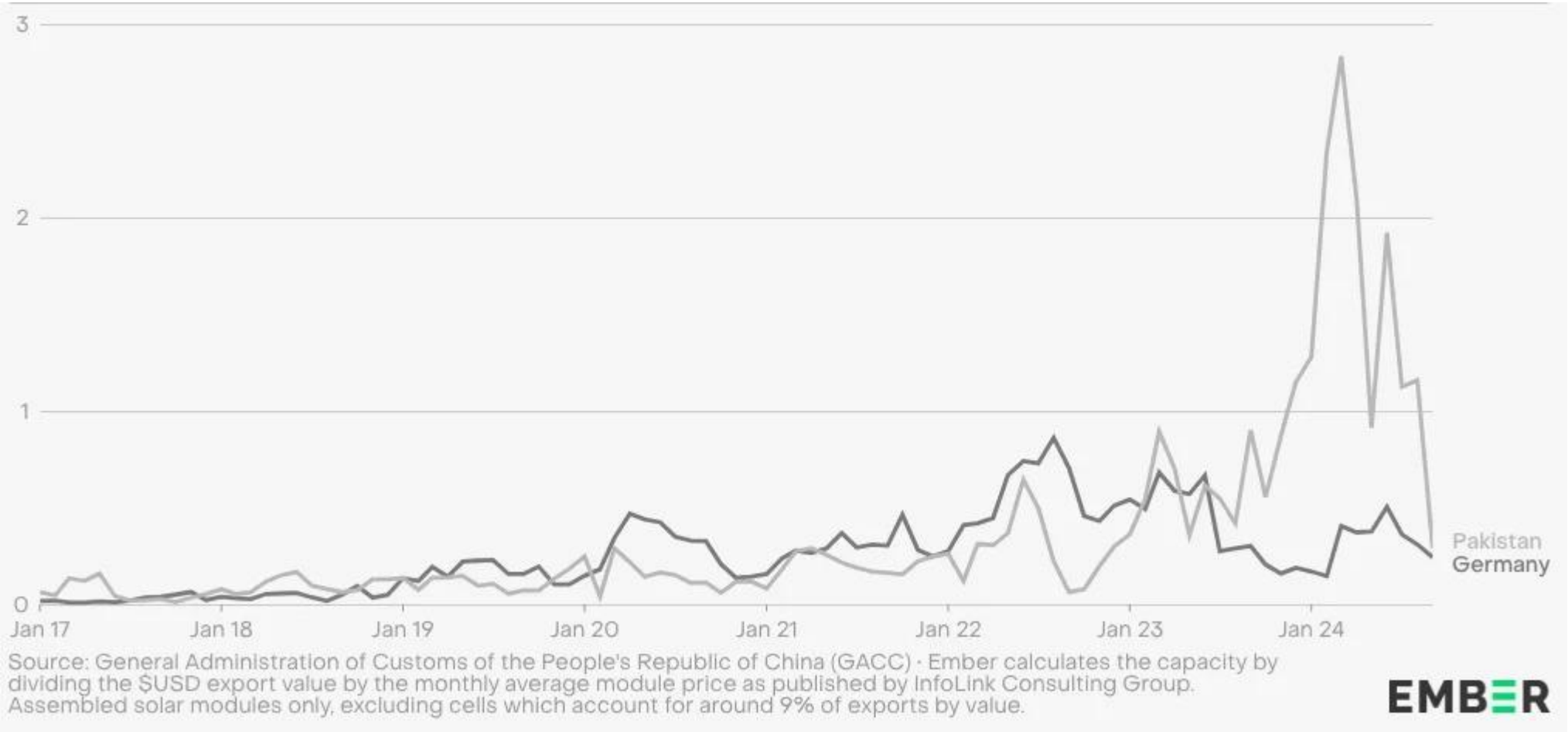
Africa aims to replicate Pakistan's extraordinary solar success

Pakistan has seen a largely unplanned explosion in rooftop solar. Data on solar panel imports for Africa suggests the continent could follow.

Solar Tsunami

26000 MWp – Solar Imports in 2022-24

30 TWh - Yearly energy production capacity



Solar Installation in Pakistan *(PRIED Study 2025)*

Regions	Net Metering (GW)	Non-Net Metered (GW)	Off-grid (GW)
Punjab	4.9	8.49	4.39
KPK	0.64	5.47	2
Sindh	0.03	3.53	1.44
Balochistan	0.02	0.93	0.48
ICT	0.44	0.57	0.01
Total	6.03	19	8.31

Residential	Commercial	Industrial	Agriculture	Total
16.66	3.73	7.91	5.04	33.34

33 GW produces 40 TWh of energy yearly (30% of Electricity Generation)

Drivers of Solar Revolution in Pakistan

- Elimination of Taxes and Duties
- Attractive Net Metering Policy
- Weak Grid
- High Electricity Rates
- High Taxes on Electricity
- Familiarity pf Public with Alternate Sources (UPSs, Generators)
- Solar Irradiance
- Reduced Loan Rates
- Collateral Free Financing
- PPAs
- Solarization of Govt. Buildings
- Horizontal Spread of Cities of Pakistan
- Flat Rooftops
- Solar Price Crash
- Modularity of Solar PV
- Variety of Solar Installation Companies
- Supply Chain Availability
- Army of Solar Installers
- Jones Effect (بھیڑ چال)

- No Carbon Financing and Limited Climate Financing

Drivers of Solar Revolution vs. Drivers of NEV Revolution!

- Elimination of Taxes and Duties
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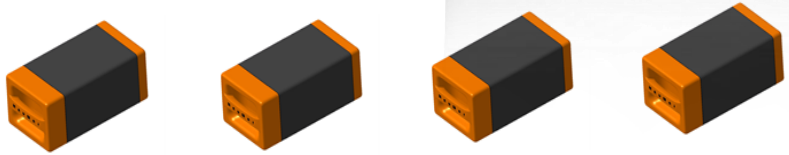
- Elimination of Taxes and Duties
- High Fuel Rates
- High Taxes on Fuel
- Cost Sharing Scheme
- Reduced Electricity Rates
- Govt. NEV Procurement
- Variety of NEV Companies
- Supply Chain Availability
- Downward Trend of Battery Prices

- Charging Infrastructure (for some vehicle categories)
- Reduced Loan Rates
- No Limit on Loan Size
- Collateral Free Financing
- Vehicle / Battery Leasing
- Army of NEV Technicians
- Carbon Financing
- Climate Financing
- Jones Effect (بھیڑ چال)

Electric Mobility as a Service (EMaaS)



3-Wheelers – Low(est) Hanging Fruit in EV Adoption

Untapped Business Opportunity

100% Commercial

2 Million Fuel-based Three-Wheelers on Roads in Pakistan

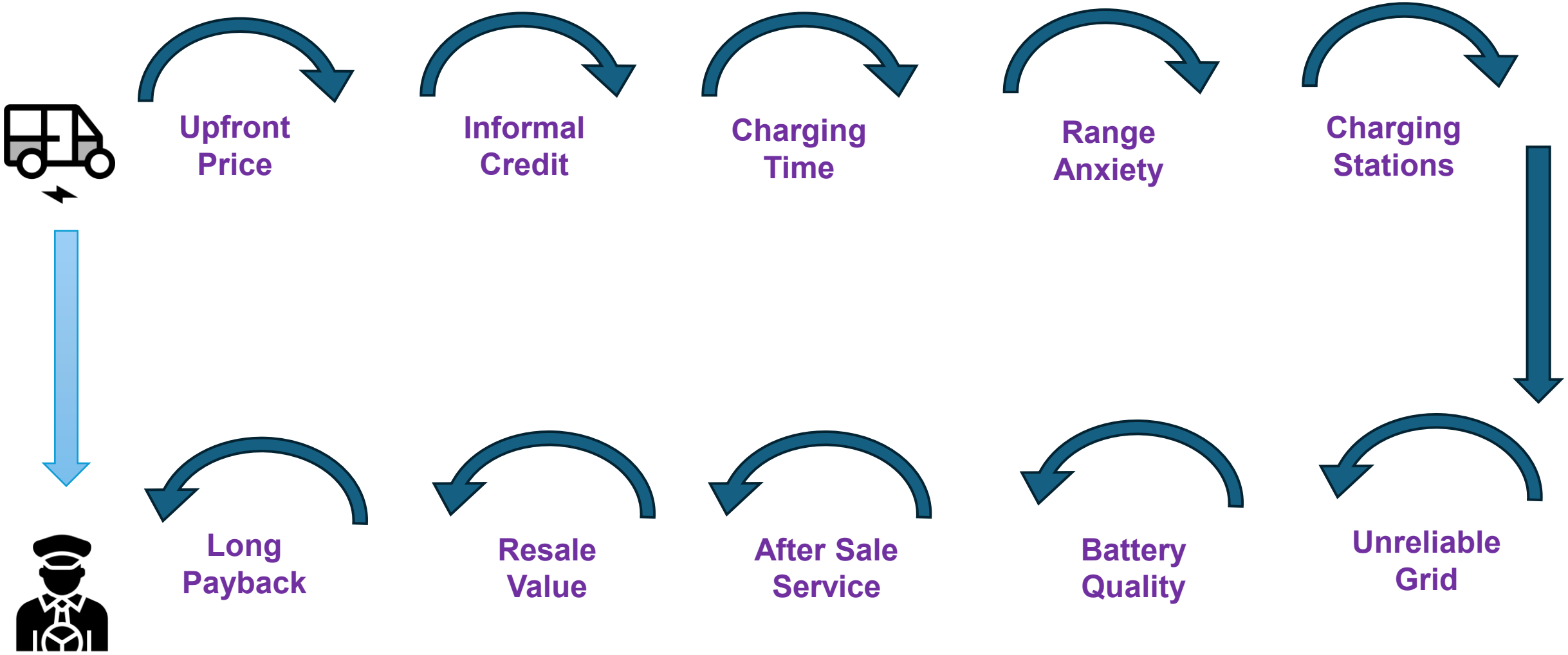
11%

YoY Growth

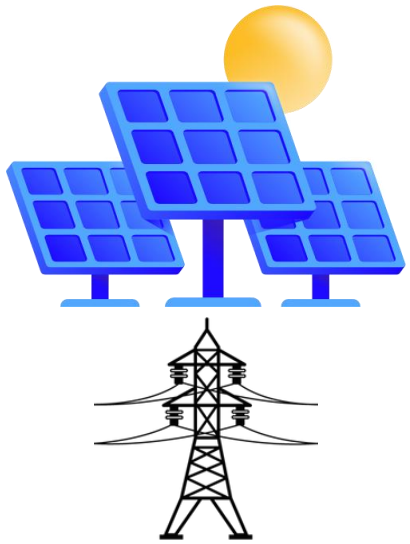
→ **Almost 53% of the 3W operations are on 'rented' vehicles**

→ **75% Ridership is Female**

Barriers to Electric 3W Adoption

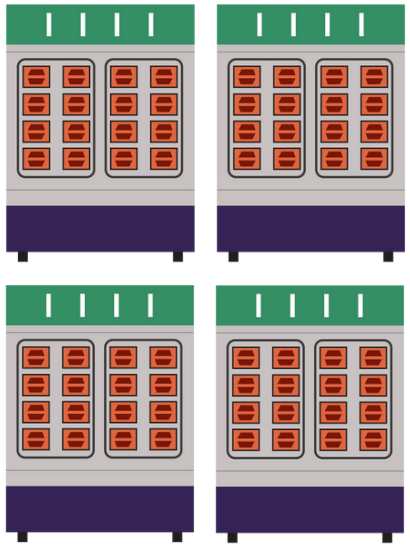


Our solution –
Mobility as a Service (MaaS) using Swappable Batteries



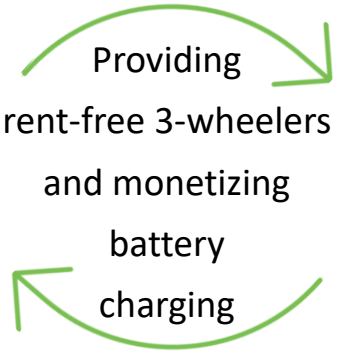
Grid-tied Solar

Charging batteries with clean energy



Battery Swapping Station (BSS)

Providing rent-free 3-wheelers and monetizing battery charging




eMobility


USAID
eMobility


eMobility

Pakistan – Battery Swapping Network

Partner Ministries	Ministry of Industries & Production; Ministry of Energy (Power Division) National Energy Efficiency and Conservation Authority; Ministry of Climate Change and Environmental Coordination
Implementation Organisations	Lahore University of Management Sciences
Project Partners	To be determined
Funding Volume Provided	To be determined
Project Duration	15 months for Detailed Preparation Phase
Status	Active
Phase	Detailed Preparation Phase
Call	Call for Projects 2023

Background: The government of Pakistan has implemented new regulations aimed at facilitating the registration of Electric Three-Wheelers (E3Ws) and expediting the issuance of manufacturing licenses for Electric Vehicle (EV) manufacturers. Despite these efforts, the adoption of EVs in the Three-Wheeler (3W) segment, which comprises approximately 2 million vehicles, remains minimal due to various underlying factors.

Approach to Transformational Change: The project aims to increase the visibility of battery swapping value chain for mobility purposes by deploying a network of swapping stations and electric-three-wheelers across Pakistan.

The project will result in an increase in the visibility of the battery swapping value chain for transportation purposes, catalyse widespread EV adoption by addressing fundamental barriers associated with typical electric vehicles having fixed batteries, develop national capacities in e-mobility, reduce vehicular airborne pollution, and attract investments in manufacturing and franchising. Additionally, challenges such as limited residential parking and frequent power outages are addressed through battery swapping, which integrates solar photovoltaic (PV) technology with Battery Swap Stations to provide renewable and alternative power sources, reduce energy charging costs, and lower greenhouse gas emissions.

The financial cooperation (FC) component supported by grant-based financing, will establish a network of BSSs in Punjab province to alleviate range anxiety and provide vehicles at zero upfront cost to early adopters, mitigating perceived risks associated with new technology adoption. It will introduce a commercially viable model with attractive returns to attract private sector investment for expanding the BSS network and increasing vehicle uptake.

The technical cooperation (TC) component of the project will provide assistance to the private sector to accelerate the development of the domestic EV industry. On the policy and regulatory front, measures will enhance public sector capacity in various areas including EV policy and regulation, standards and road safety, electricity supply planning and tariff design, gender diversity and social inclusion, environmental protection, and battery and solar PV recycling.

Mitigation potential: It is estimated that the project could directly reduce 250.000 tCO_2e during its implementation timeline and more than 1.200.000 tCO_2e over lifetime of the supported technologies.

IMAGE: © MORTENROCHSSARE

2023 Call for Projects
500 Projects Submitted
6 Selected for Funding

Mitigation Action Facility

Competitive Funding for Decarbonization Projects in

- Transport
- Industry
- Renewable Energy

https://mitigation-action.org/projects/pakistan-swappable-battery-based-network-for-promoting-electric-vehicles

Renewable Transformation Challenge 2025: Meet the top 10!

03. July 2025

ISES and Elsevier are excited to introduce the top 10 entries of the Renewable Transformation Challenge 2025 to you!

These top 10 entries were selected out of 150+ applications we received for the challenge this year and they represent exciting renewable energy projects from all around the world and were carefully selected by our expert jury of international solar experts over the past week.

https://www.ises.org/news/renewable-transformation-challenge-2025-meet-top-10

AGRISOL: Rural Agriculture Powered by Solar Energy - Indonesia

AGRISOL is a decentralized renewable energy solution for rural agriculture, built to replace fossil-fuel-powered tools with affordable solar alternatives. It introduces a two-part system: A solar-charged battery swap station located in farming areas. Solar-powered agriculture tools AgriSol-Pump, a portable solar water pump operated by the batteries from the station. For many farmers in Indonesia, the cost of petrol-based agriculture tools such as irrigation pumps is so high that letting crops fail is sometimes the only choice. AGRISOL-pump enables farmers to significantly reduce their production costs while eliminating the need for petrol and reducing carbon emissions. By collaborating with vocational schools for production and maintenance, AGRISOL also builds local skills and service capacity, laying the groundwork for both sustainability and local empowerment.

BIOGREENFINERY - Spain

BIOGREENFINERY is a pilot renewable-fuel facility at ITC in the island of Gran Canaria integrating a hybrid off-grid microgrid (solar, wind, battery, biodiesel backup) with PEM and alkaline electrolysis, nitrogen generation, and a Haber–Bosch reactor to produce green hydrogen and ammonia. It fuels a hydrogen-fuel-cell bus and two cars, demonstrating zero-carbon transport in an isolated region. Backed by around 6 M€ from EU REACTEU and aligned with the Canary Islands' 2040 decarbonisation target and EU Green Deal, the project validates the technical feasibility and economics of e-fuel production in remote areas. As a 'e/bio fuels platform," it enables continuous operation, data collection, and a blueprint for scaling renewable fuels in hard-to-abate sectors.

Comprehensive PV Implementation – Lebanon

This project has resulted in the installation of 130 KW for water pumping in 2 sites, nine 1.6 KW system for needy households, 140 KW for main HQ, 22 KW for a recreational site, 23 KW for a school, and 7.6 KW for an organization's branch A total of 350KW of PV were installed and 150,000 individuals are benefitting from the installed systems which are generating more than 250 MWh annually. These have resulted in annual savings exceeding $50,000. All systems are on/off grid systems capable of independent operation and energy storage in batteries, while having the ability to feed back into the grid in case the mains electricity becomes available, and PV production exceeds the immediate needs. Local individual funding of all the implemented projects insures overall project sustainability and expandability.

GreenBox – Congo

GreenBox is a 100% solar-powered cold storage solution designed to eliminate food spoilage and post-harvest losses in developing countries, where up to 50% of horticultural produce is wasted before reaching consumers. Installed in farming groups, aggregation centers, and markets, GreenBox cold rooms enable smallholder farmers, retailers, and wholesalers to store perishable foods 24/7, extending shelf life from 2 to 21 days. The project's primary objective is to ensure food security, increase farmer income, and reduce poverty by providing affordable, sustainable cold storage at critical points in the food chain. By preserving food quality and preventing spoilage, GreenBox helps deliver safe, nutritious food to local communities while advancing climate resilience and economic empowerment. The primary objective of GreenBox™ is to empower farming communities by reducing food spoilage.

Hybrid Solar Dryers for Resilient Food Systems – Mexico

The project develops and implements a hybrid renewable energy system for food drying in rural Zacatecas, Mexico. It integrates direct and indirect solar thermal technologies, PV-T panels, and a PV solar-powered heat pump, with optional LPG and biomass backup to ensure year-round resilience. The primary objective is to reduce post-harvest losses and fossil energy dependency by deploying a replicable, low-emission, community-based drying solution powered primarily by solar renewable energy. The project enhances food preservation, strengthens rural livelihoods, and contributes to climate resilience and sustainability in vulnerable agroecosystems.

Kokota and Njau Islet Solar Electrification Project - Tanzania

The Kokota and Njau Islet Solar Electrification Project is a flagship renewable energy initiative spearheaded by Photons Energy Limited, aimed at delivering sustainable and reliable electricity to two remote off-grid communities located on Kokota and Njau Islets in the Pemba region of Zanzibar, Tanzania. These islets are home to vibrant fishing communities who, for decades, lacked access to electricity and depended on costly and environmentally harmful energy sources such as diesel generators, kerosene lamps, and disposable batteries. The lack of reliable energy limited access to clean water, education, healthcare, and economic opportunities. The primary objective is to provide universal access to clean, affordable, and sustainable electricity to the residents of Kokota and Njau through the deployment of solar-powered mini-grid systems. This is in line with SDG 7 on clean energy for all.

Scaling Up Energy Access in Malawi with minigrids – Ireland

The goal of the Scaling Up Energy Access in Malawi (SEAM) project is to provide accessible green energy to households and rural communities in Dedza District, Malawi. As part SHA Malawi's efforts since 2008 to develop and implement market-based green energy solutions for cooking, lighting, and 'productive uses of energy', the SEAM project promotes the use of interconnected 'solar mini-grids', off-grid, electricity generation and storage installations that provide access to reliable, renewable, clean energy for rural communities. The UN set Sustainable Development Goal (SDG) 7 to tackle the issue of 760 million people living without access to electricity, 75% of whom live in sub-Saharan Africa. Malawi is particularly burdened, with only 14% of the population having access to National Grid electricity. Rural access to electricity is even lower, sitting at a mere 1% despite 85% of the country's population living in rural areas. Expansion of the National Grid is forecasted to be more than 20 years away for a significant proportion of Malawi's rural population. This ongoing lack of access to electricity severely affects quality of life and stalls economic development meaning alternative energy solutions are needed now.

Solar-powered Battery Swapping for Urban Mobility – Pakistan

This project demonstrates the deployment and evaluation of Pakistan's first decentralized, solar-powered battery swapping infrastructure for electric three-wheelers (e3Ws). The project is implemented in Multan, a secondary city with high vehicular pollution and limited mass transit, using a mobility model powered by renewable energy. 20 swappable battery-based e3Ws and 2 Battery Swapping Stations (BSSs) were launched. One BSS was powered by a 20 kWp solar PV hybrid system. The objective was to analyze the technical, economic, and social viability of powering last-mile urban mobility using renewable energy. The project reduced vehicular CO emissions by up to 70%, improved energy efficiency by 80% over oil-based 3Ws, and achieved 92% driver retention and 97% passenger preference. The project is a replicable model for climate vulnerable urban centres and leads towards sustainable mobility.

SunstorePowerpan at the Khoisan solar shelter - United Kingdom

The SunstorePowerpan is a hybrid solar/bio-char combined cooking and electricity generating appliance, designed to be the world's most cost effective and carbon negative feeding station for institutions and off-grid communities. It uses a modular, inverted PMMA Fresnel lens array, to concentrate up to 1kW of solar flux on to a flat plate aluminum heat pipe absorber. This energy is delivered by latent transfer, into an insulated 30 litre cooking pan. Six solar cycles per day are possible in good solar

Turning Waste to Clean Cooking Energy – Tanzania

Bantu Technologies is transforming biomass waste into clean, affordable cooking energy through biomass briquettes and stoves. Based in Zanzibar, our project tackles deforestation, waste pollution, and energy poverty by replacing charcoal with briquettes made from bagasse and other organic waste. Our primary objective is to accelerate the transition to renewable energy for cooking in underserved communities while promoting circular economy principles. With over 20% monthly user growth and positive