EFFICIENCY FOR ACCESS

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Transforming Energy Access

IKEA Foundation

Efficiency for Access Design Challenge 2024-2025

Final submission summaries

May 2025

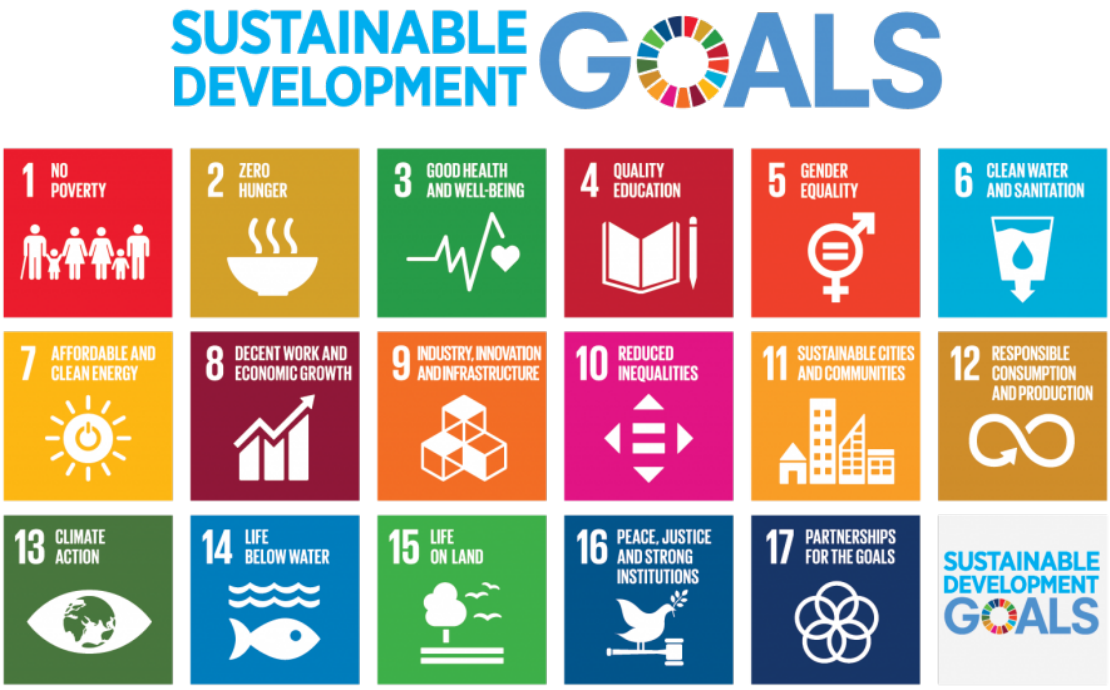
Efficiency for Access Coalition

Contents

Abbreviations

AC	Alternating current
AI	Artificial intelligence
BLDC	Brushless direct current
DC	Direct current
GPS	Global positioning system
GSM	Global system for mobile communications
kg	Kilogram
IoT	Internet of Things
LCD	Liquid crystal display
LED	Light emitting diode
LPG	Liquid petroleum gas
ml	Millilitre
NGO	Non-government organisation
PID	Proportional-integral-derivative
PV	Photovoltaic
QR	Quick-response
RFID	Radio frequency identification
SDG	Sustainable Development Goal
UV	Ultraviolet
UV-C	Ultraviolet-C
UV-LED	Ultraviolet light emitting diode
V	Volt
W	Watt

Sustainable Development Goals (SDGs)



Foreword

The Efficiency for Access Design Challenge is a global, multi-disciplinary competition that empowers teams of university students to help accelerate clean energy access. To provide sustainable energy for all, we urgently need to enhance the efficiency and affordability of high-performing appliances. The Challenge invites teams of university students to create affordable and high-performing solar appliances and enabling technologies.

By bringing together and inspiring students, the competition aims to foster innovation in the solar appliance sector. It also seeks to help address barriers that limit market expansion in this area. Furthermore, the Challenge seeks to forge beneficial partnerships between universities, researchers, and industry partners at a global level. In this way, it will further strengthen academic capacity within the off-grid sector.

As delivery partners, Energy Saving Trust, co-Secretariat of Efficiency for Access, and Engineers Without Borders UK are delighted to collaborate on the Efficiency for Access Design Challenge. Efficiency for Access is coordinated jointly by CLASP and Energy Saving Trust. The Challenge is funded by UK aid via the Transforming Energy Access programme, and the IKEA Foundation. To learn more about the Challenge, please read this year's Challenge Handbook.

In the sixth year of the Challenge, over 160 students from 18 universities in Bangladesh, Ethiopia, India, Kenya, Nigeria, Rwanda, Senegal, Uganda, the United Kingdom, and Zimbabwe have participated and were supported by more than 40 industry partners. The students have spent the year creating innovative designs for off-grid settings and the final submissions are summarised in this document.

Summary Table

The table below summarises the projects that students submitted as part of the Efficiency for Access Design Challenge 2024-2025.

Team	University	Project title	Theme	Full report	Video submission	Team members
2024-02	Strathmore University and City University, London	Solar-powered grain mill	Agriculture	Full report	Video submission	Lemi Tereka, Lucy Siamanta
2024-03	Strathmore University	Jua Sheller	Agriculture	Full report	Video submission	Hisa Mureithi, Robert Kwach, Ruth Mumba, Titus Muli
2024-04	Strathmore University	Solar-powered water purification system	Water and sanitation	Full report	Video submission	Michelle Wafula, Roby Kabiss, Sharifu Jirani
2024-05	National University of Science and Technology	Solar-powered peanut butter maker	Agriculture	Full report	Video submission	Hope T Nyabote, Malvin Ndume, Olivier Chikwezvero, Tafara Zhanhi
2024-06	National University of Science and Technology	Solar-powered infra-red lamp for a chicken pen	Agriculture	Full report	Video submission	Chikoromo Sean, Fotsho Hutchins H, Moyo Seabed P, Seremani Jordan P
2024-08	Gulu University	Hydrogel solar evaporator	Water and sanitation	Full report	Video submission	Bakulumpagi Aloysious G, Madoi Shaidu, Nyamungu Rosemary, Ojede Brian Stephen
2024-09	Gulu University	Solar-powered photocatalysis for water purification	Water and sanitation	Full report	Video submission	Atuha Elisha Arone, Atyang Andrew, Munguci Saviour, Okot Simon Peter
2024-10	Aston University	Solar-powered glass recycling to sand	Other	Full report	Video submission	Evandro Cristóvão, Kiran Chatha, Yash Chawan, Zahrah Azeem

Team	University	Project Title	Theme	Full Report	Video Submission	Team Members
2024-11	Aston University	Solar-powered sanitary pad vending machine	Healthcare	Full report	Video submission	Irene Thanprasert, Mohamed Raees Khan, Raunak Sharma, Walid Alfaghi
2024-13	University of Rwanda	Solar-powered tea leaf harvester	Agriculture	Full report	Video submission	Alexis Mugisha, Blaise Jimmy Gatera, Olivier Muhirwa Nkusi, Uwase Karamaga, Yvonne Muhoza
2024-14	University of Rwanda	Solar-powered grain silo solution	Agriculture	Full report	Video submission	Amahoro Uwase Joella, Igihozo Irene Robert, Ndisanze Nkwaya Bohneur, Niyonzima Albert, Turizimana Esther
2024-17	University of Rwanda	Solar-powered fishpond aerator	Agriculture	Full report	Video submission	Iradukunda Cedrick, Mbeshejwehonayo Elisa, Mugisha Didier Bonheur, Niyomugabo Benjamin, Zachariah Assouman
2024-21	National University of Science and Technology	Solar-powered water purification (UV LED lamps)	Water and sanitation	Full report	Video submission	Celine Njoma, Janet Rudo Chapunza, Liberty Sachiwo, Simbarashe Jonasi, Walter Moyosvi
2024-23	University of Zimbabwe	Solar-powered induction cooker	Cooking	Full report	Video submission	Chikwanah Ngoni, Chitambira Tinotenda B, Mativenga Abnezary

Team	University	Project Title	Theme	Full Report	Video Submission	Team Members
2024-24	University of Zimbabwe	Sorad fridge: solar radiation refrigerator	Refrigeration	Full report	Video submission	Otto Murapa, Tanyaradzwa Sango
2024-25	University of Zimbabwe	Solar water purification system	Water and sanitation	Full report	Video submission	Chiremba Chessmore, Mikombe Rugare, Pswarai Simbarashe, Zimudi Tadiwanshe
2024-28	Independent University, Bangladesh (IUB)	Solar-powered food dehydrator with smart moisture control	Agriculture	Full report	Video submission	Faria Afrin Khan, Md. Fardous Mahmud Fahim, Samiul Hasan
2024-30	University of Nigeria, Nsukka	Solar-powered milling machine for rural communities	Agriculture	Full report	Video submission	Chukwuemeka Ani, Ejima Enemona Elijah, Joy Chiezie, Nonso Onwuazor, Overcomer Chiedozie
2024-32	Kalasalingam Academy of Research and Education	Solar-powered medical supply drones	Healthcare	Full report	Video submission	Bharath Kumar Y, Kavin Kumar S, M Bhavani, Padmini A, Sri Darshni Thayalan
2024-33	Kalasalingam Academy of Research and Education	Solar-powered DC refrigeration units	Refrigeration	Full report	Video submission	B Likitha, B Sri Durga Prasad, D Meghana, K Abhinav, V Sai Kiriti
2024-34	Kalasalingam Academy of Research and Education	Solar-powered smart irrigation and fertiliser system	Agriculture	Full report	Video submission	Arun S, J Beaula Jenefa, Nalla Suneela, Thummala Nithin Reddy, V Siva Rami Reddy

Team	University	Project Title	Theme	Full Report	Video Submission	Team Members
2024-36	Independent University, Bangladesh (IUB)	Development of a portable foetal heart monitoring device	Healthcare	Full report	Video submission	Muhammad Sajid Hossain, Samara Islam, Tasfia Hasan Faiza
2024-39	Independent University, Bangladesh (IUB)	Solar power based electric boat	E-mobility	Full report	Video submission	Brishti Dhar, Md. Parvez Sultan, Md. Shahariar Parves, Md. Yasin Altaf, Sajid Zafry Ahsan
2024-40	Makerere University	Solar-powered grey-water recycling	Water and sanitation	Full report	Video submission	Kalwanyi Richard, Nassiwa Catherine, Sserunjogi Ahmed Mansul
2024-41	King's College London	Low-cost solar-powered water carrier	Water and sanitation	Full report	Video submission	Daniel Gatward, Ho Lun Wong, Mihaela Alexia Hostiuc
2024-42	King's College London	Low-Cost solar-powered IoT water station	Water and sanitation	Full report	Video submission	Essa Abikar, Wei Cheng, Zhiyi Zhuang
2024-44	Dakar American University of Science and Technology	Smart irrigation solar system	Agriculture	Full report	Video submission	Arame Bousso, Sira Oumou Khairy Diallo, Vanessa Deffo, Yacine Ba
2024-46	Makerere University	An affordable smart solar-powered poultry feeding system	Agriculture	Full report	Video submission	Buyungo John Baptist, Lubega Juma
2024-48	Makerere University	Eco solar cassava flash dryer	Agriculture	Full report	Video submission	Agilo Joyce Ruth, Bananuka Lynnette, Ojok Oscar Brian

Team	University	Project Title	Theme	Full Report	Video Submission	Team Members
2024-49	University of Port Harcourt	Design and construction of DC garri frying machine	Cooking	Full report	Video submission	Felicia Friday Paul-Jazom, Sam-Ogide Adiela, Sunday Boyewa Edema, Uchenna Gregory Mbah, Uwemedimo Uduak Frank
2024-50	Federal University of Technology Owerri	Solar-powered water purification system for domestic use	Water and sanitation	Full report	Video submission	Dominic Ogodo, Madu-Chikwendu Crystal, Salam Ridwan, Okechukwu Ochulor, Vincent Okechukwu
2024-52	Usmanu Danfodiyo University, Sokoto	Design of a solar-powered sugarcane juice extractor	Agriculture	Full report	Video submission	Aminu Fatima Musa, Sunday Victor
2024-53	Mekelle University	Solar DC dryer for post-harvest preservation of crops	Agriculture	Full report	Video submission	Hiluf Alemu Adihena, Yared Selemon Bogale, Znabu Mehari Gebrezgi
2024-54	Obafemi Awolowo University Ile-Ife	Low-cost solar powered neonatal incubator	Healthcare	Full report	Video submission	Abe Boluwatife Christianah, Abilewa Ayomide Michael, Dhikrullahi Ibrahim Kayode
2024-55	Obafemi Awolowo University Ile-Ife	Solar-kinetic RFID cattle tagging system	Agriculture	Full report	Video submission	Ayelagbe Timothy, Olaoti Favour Omotola, Oloyede Elijah
2024-56	Obafemi Awolowo University Ile-Ife	Solar-powered irrigation system (SPIS)	Agriculture	Full report	Video submission	Ayanyori Olamide, Oluwafemi Emmanuel, Soyinka Enoch

Team 2024-02 — Solar-Powered Grain Mill

Lemi Tereka, Lucy Siamanta

Theme: Agriculture

Project Summary

This project focuses on designing a solar-powered grain mill system for off-grid rural communities in Narok County, Kenya. The system aims to address challenges such as unreliable energy access, high milling costs, and limited infrastructure. By leveraging solar energy, the grain mill enhances food security, reduces environmental impact, and promotes sustainable agricultural practices.

Innovation

The solar-powered grain mill utilises a high-efficiency 48V DC motor directly powered by a solar PV array, eliminating the need for inverters and reducing energy losses. The system is modular, supporting local assembly and repair, and integrates locally assembled batteries to increase circularity.

Sustainability

The project aligns with several SDGs, including SDG 7 (Affordable and clean energy), SDG 2 (Zero hunger), SDG 1 (No poverty), and SDG 13 (Climate action). It helps to reduce greenhouse gas emissions by avoiding fossil-fuel generators and prioritises the reuse of components.

Social Impact

The solar-powered grain mill improves the quality of life by providing local, reliable milling services, saving travel time and transport costs. It generates employment opportunities for local technicians and supports women-led cooperatives.

Business Model

The business model targets rural households and smallholder farmers, offering a plug-and-play, inverter-less solar grain mill. The growth plan includes pilot deployment in Narok County, followed by partnerships with savings and credit cooperative organisations and NGOs to accelerate market penetration and adoption.

Team 2024-03 — Jua Sheller

Hisa Mureithi, Robert Kwach, Ruth Mumba, Titus Muli

Theme: Agriculture

Project Summary

The jua sheller is a solar-powered maize seed remover designed to enhance efficiency and reduce manual labour for small-scale farmers in Kilifi County, Kenya. It provides a sustainable and cost-effective solution to traditional shelling methods, which are labour-intensive and environmentally harmful.

Innovation

The jua sheller seeks to improve productivity, reduce labour intensiveness and reduce injuries that traditional methods can cause. Its use of solar power, alongside local manufacturing further increases the sustainability of existing options that farmers use.

Sustainability

The project is more sustainable than existing diesel-powered shellers, reducing greenhouse gas emissions associated with the running of the machine. Due to its use of local manufacturing, it will also help reduce the greenhouse gas emissions involved in transporting alternative appliances long distances.

Social Impact

The Jua Sheller improves the quality of life by reducing manual labour and injuries associated with traditional shelling methods. It creates job opportunities through local manufacturing, operation, and maintenance services.

Business Model

The business will provide access to the appliance as a service to farmers, and several possible financials models are identified, including pay-per-use, leasing, direct sales, and pay-as-you-go to ensure affordability and accessibility. The farmers would pay a service fee of the cost of a percentage of their harvest.

Team 2024-04 — Solar-Powered Water Purification System

Michelle Wafula, Roby Kabiss, Sharifu Jirani

Theme: Water and Sanitation

Project Summary
This project aims to design and implement a solar-powered water purification system for communities in Machakos County, Kenya. The system addresses challenges such as water pollution, health risks, and unreliable water supply by utilising renewable energy and advanced filtration technologies.

Innovation
The solar-powered water purification system uses a modular structure allowing for adaptability to serve small households or larger communities. It uses advanced filtration methods including nanotechnology membranes, and UV sterilisation. The system includes sensors for real-time monitoring as well as a mobile app to enhance user engagement.

Sustainability
The project supports SDG 6 (Clean water and sanitation) by providing access to safe drinking water, SDG 7 (Affordable and clean Energy) through solar power, and SDG 13 (Climate action) by reducing greenhouse gas emissions. It prioritises recyclability and durability to minimise environmental impact.

Social Impact
The system improves public health by reducing waterborne diseases and long-term health risks. It creates job opportunities through local manufacturing, installation, and maintenance, and promotes social inclusiveness by targeting underserved communities.

Business Model
The business model includes flexible payment options such as microfinancing, subsidies, and community partnerships to ensure affordability. The growth plan involves pilot projects, local manufacturing, and awareness campaigns to promote the system's benefits and expand its reach.

Team 2024-05 — Solar-Powered Peanut Butter Maker

Hope T Nyabote, Malvin Ndume, Olivier Chikwezvero, Tafara Zhanhi

Theme: Agriculture

Project Summary

The solar-powered peanut butter maker is designed to streamline the process of grinding peanuts into high-quality peanut butter, addressing key barriers to productivity and accessibility in rural and underserved communities. Powered by a solar system and equipped with a BLDC motor, the machine offers improved productivity, reduced environmental impact, and enhanced accessibility for smallholder farmers and households.

Innovation

The system utilises a 24V solar-powered BLDC motor, which is efficient and reliable. The design reduces costs associated with making peanut butter, through reduced labour costs of manual grinding, reduced energy costs through solar power, and low maintenance costs due to durable construction. The machine is designed for ergonomic use, with features like one-hand operation and easy feeding mechanisms to accommodate users with limited mobility.

Sustainability

The project promotes the use of renewable energy, reducing reliance on fossil fuels and minimising greenhouse gas emissions. It supports sustainable farming practices and contributes to several SDGs, including SDG 2 (Zero hunger), SDG 7 (Affordable and clean energy), and SDG 13 (Climate action).

Social Impact

The machine improves quality of life by reducing manual labour, enhancing productivity, providing economic opportunities, and increasing accessibility to nutrient dense food. It uses inclusive design principles and aims to be accessible to people with disabilities through height adjustability, a user-friendly interface, ergonomic design and safety features. It targets and supports smallholder farmers, women, and individuals with disabilities, promoting inclusivity and community development.

Business Model

The business model targets smallholder farmer cooperatives, NGOs, and community groups, offering financing options and payment plans to ensure affordability. The growth plan includes prototype development, pilot testing, and broader rollout through partnerships and marketing efforts.

Team 2024-06 — Solar-Powered Infra-Red Lamp for a Chicken Pen

Chikoromo Sean, Fotsho Hutchins H, Moyo Seabed P, Seremani Jordan P

Theme: Agriculture

Project Summary

The solar-powered infra-red lamp for a chicken pen aims to provide a sustainable and efficient solution for poultry farming, particularly during cold weather. Utilising solar energy, the smart brooder system maintains optimal temperature, humidity, and oxygen levels for chicks, reducing mortality rates and improving productivity.

Innovation

The system integrates solar panels, a charge controller, and a battery bank to store energy. It uses temperature, humidity, and carbon dioxide sensors to monitor real-time conditions. The core component is an Arduino Mega 2560 microcontroller with a PID control algorithm to regulate temperature. The system includes LCD displays, buttons for user interaction, and a speaker for audio feedback.

Sustainability

The project aligns with several SDGs, including SDG 2 (Zero hunger), SDG 7 (Affordable and clean energy), SDG 12 (Responsible consumption and production), and SDG 13 (Climate action). Furthermore, the project has additional relevance for SDG 1 (No poverty), SDG 8 (Decent work and economic growth), and SDG 17 (Partnerships for the Goals).

Social Impact

The smart brooder system improves quality of life for poultry farmers by ensuring a consistent and reliable source of heat for chicks. It generates employment opportunities in manufacturing, assembly, and maintenance. The system also supports community development by empowering farmers to raise chickens year-round, increasing income and food security.

Business Model

The business model targets small-scale poultry farmers in rural and urban areas with unreliable grid power. It includes partnerships with agricultural cooperatives, NGOs, and chick suppliers. The growth plan involves scaling production and distribution, raising awareness through social media and demonstrations, and securing funding for manufacturing and marketing.

Team 2024-08 — Design of a Hydrogel Solar Evaporator for Water Purification

Bakulumpagi Aloysious G, Madoi Shaidu, Nyamungu Rosemary, Ojede Brian Stephen

Theme: Water and sanitation

Project Summary

This project addresses the critical need for safe drinking water and reliable electricity in Ugandan refugee camps. The hydrogel solar evaporator uses solar energy and hydrogel materials to purify contaminated water through solar evaporation. This innovative system is eco-friendly, sustainable, and inexpensive, making it ideal for off-grid areas. It aims to reduce reliance on fossil fuels and electricity, promoting healthier communities and aligning with several SDGs.

Innovation

The hydrogel solar evaporator combines solar power with hydrogel materials, specifically chitosan polypyrrole hydrogel, to absorb and purify water. The system operates off-grid, reducing emissions and providing a sustainable solution for water purification. It features modular components for capacity increases and user-friendly controls, ensuring easy operation and monitoring.

Sustainability

The project promotes sustainability using biodegradable hydrogels and solar energy. It reduces carbon emissions significantly compared to traditional boiling methods and contributes to SDGs such as SDG 6 (Clean water and sanitation), SDG 7 (Affordable and clean energy), SDG 9 (industry, innovation and infrastructure), SDG 12 (Responsible consumption and production), and SDG 13 (Climate action).

Social Impact

The hydrogel solar evaporator improves health by reducing waterborne diseases, decreasing the labour burden on women and children, creating employment opportunities, and fostering economic growth. It ensures inclusivity by providing affordable and durable water purification solutions for off-grid communities, including refugee camps.

Business Model

The business model targets refugee camps and rural areas, offering a sustainable and low-cost solution for water purification. It includes payment options such as pay-as-you-go, one-time payment, and a subscription model. The growth plan involves forming teams, securing funding, prototype development, testing, and deployment in refugee camps, with partnerships for vocational training and community engagement.

Team 2024-09 — Solar-Powered Photocatalysis for Water Purification

Atuha Elisha Arone, Atyang Andrew, Munguci Saviour, Okot Simon Peter

Theme: Water and sanitation

Project Summary

The solar-powered photocatalysis for water purification system aims to address the challenge of safe drinking water in off-grid areas of Yumbe District, Uganda. Utilising solar energy to power UV-C LEDs, the system activates titanium dioxide nanoparticles to purify water through photocatalysis. This process breaks down organic pollutants and pathogens into harmless substances, providing an efficient, cost-effective solution for water purification in remote areas without reliable electricity.

Innovation

The designed system combines solar power with advanced photocatalysis technology. Key components include solar panels, battery storage, a DC pump, UV-C LEDs, and ceramic filters. The use of titanium dioxide nanoparticles enhances the purification process, making it effective in degrading pollutants and pathogens. The system is designed for simplicity, durability, and rapid deployment in off-grid areas.

Sustainability

This system promotes environmental sustainability by using eco-friendly materials and renewable solar energy. It aligns with several SDGs including SDG 6 (Clean water and sanitation), SDG 3 (Good health and well-being), SDG 7 (Affordable and clean energy), SDG 13 (Climate action), and SDG 9 (Industry, innovation, and infrastructure). The system minimises environmental impact throughout its lifecycle, with recyclable components and responsible disposal practices.

Social Impact

The adoption of this system improves access to safe drinking water, reducing the risk of waterborne diseases and enhancing public health. It provides employment opportunities through training on installation, operation, and maintenance. The system alleviates the burden of water collection, particularly for women and girls, promoting gender equality and enabling participation in education and economic activities.

Business Model

The business model targets water-insecure households, host communities, refugee settlements, schools, and health facilities. Revenue streams include subscription fees through a pay-as-you-go model, direct sales to NGOs and government agencies, and donation partnerships. The growth plan includes prototype refinement, pilot deployment, community awareness campaigns, and regional expansion.

Team 2024-10 — Solar-Powered Glass Recycling to Sand

Evandro Cristóvão, Kiran Chatha, Yash Chawan, Zahrah Azeem

Theme: Other

Project Summary
The project involved a solar-powered machine to convert discarded glass bottles into glass sand. This addresses the issues of sand scarcity and glass waste in Maralal, Kenya, providing a sustainable alternative to traditional sand mining and promoting environmental conservation.

Innovation
The innovative machine uses renewable energy to process glass bottles into high-quality sand, reducing the need for unsustainable mining practices and minimising carbon footprint. The machine is both compact and modular, meaning it can be easily transported and integrated into various community set ups.

Sustainability
The machine mitigates greenhouse gas emissions by using solar power, consuming less energy than traditional sand extraction. By using waste glass to produce glass sand, the product frees up landfill space and eliminates the cost and effects of transporting glass to recycling centres. It also lowers the demand for sand extraction from beaches and rivers, reducing the effects of traditional extraction on the environment. The project aligns with several SDGs including SDG 8 (Decent work and economic growth), SDG 9 (Industry, innovation, and infrastructure), SDG 11 (Sustainable cities and communities), SDG 12 (Responsible consumption and production), and SDG 13 (Climate action). It promotes a circular economy by recycling glass waste.

Social Impact
The project creates local job opportunities in bottle collection, machine operation, and machine maintenance, offering an alternative for young people working in sand harvesting mines. It supports safer waste disposal and provides low-cost construction material, addressing the environmental and health risks associated with traditional sand mining and improving community infrastructure and well-being.

Business Model
The business model includes leasing options for local businesses and larger companies, as well as municipal recycling programs. It emphasises community engagement and awareness programs to promote the adoption of glass sand.

Team 2024-11 — Solar Flow: Sustainable Women Care at Indonesian Fingertips through Smart Solar-Powered Period Pad Vending Machines

Irene Thanprasert, Mohamed Raees Khan, Raunak Sharma, Walid Alfaghi

Theme: Healthcare

Project Summary

This project addresses menstrual health and period poverty in Kupang, Indonesia, by introducing solar-powered vending machines for sanitary pads. These machines aim to improve the accessibility and affordability of menstrual products, reduce environmental impact, and foster economic growth through job creation. The initiative aligns with the SDGs by addressing social, economic, and environmental issues related to menstrual health.

Innovation

The vending machines are powered by solar energy, making them ideal for off-grid areas. They offer both cash and online payment options (QR code), ensuring accessibility and user convenience. The machines are designed with sustainable materials, including recycled aluminium and biodegradable plastics, and feature IoT connectivity for real-time data tracking and efficient restocking.

Sustainability

The project promotes sustainability by using renewable energy and sustainable materials, reducing greenhouse gas emissions, and supporting a circular economy. The machines are designed to minimise environmental impact throughout their lifecycle, from manufacturing to disposal. The initiative also plans to use 100% biodegradable pads and integrate waste disposal systems to further reduce environmental footprint.

Social Impact

The vending machines improve menstrual health by providing affordable and hygienic products, reducing the stigma associated with menstruation, and enhancing the quality of life for women and girls. The project creates employment opportunities in manufacturing, distribution, maintenance, and education. It also ensures inclusivity by targeting marginalised communities and collaborating with NGOs and government programmes. The project offers pricing options that include subsidies to enhance accessibility for individuals who wouldn't otherwise be able to afford the pads.

Business Model

The business model targets low-income areas and includes partnerships with local organisations for distribution and education. The machines are strategically placed in community centres, schools, and health clinics to maximise accessibility. The growth plan involves expanding to other regions in Indonesia and potentially other countries, with a focus on scalability and sustainability.

Team 2024-13 — Solar-Powered Tea Leaf Harvester

Alexis Mugisha, Blaise Jimmy Gatera, Olivier Muhirwa Nkusi,
Uwase Karamaga, Yvonne Muhoza

Theme: Agriculture

Project Summary

The solar-powered tea leaf harvester is designed to address the critical challenges in Rwanda's tea sector, including high labour costs, inconsistent product quality, and environmental degradation. It aims to improve efficiency, reduce operational costs, and enhance the quality of tea leaves harvested, thereby boosting farmer profits and supporting long-term sustainability.

Innovation

The harvester integrates solar power with advanced harvesting technology and a lithium-ion battery to ensure operation even with low sunlight conditions for up to six — eight hours per charge. Key features include a high-efficiency photovoltaic system, a cutter bar with adjustable height settings, and an ergonomic design for ease of use. The machine is lightweight (2kg) and easy to handle, suitable for the country's hilly tea plantations. It also includes real-time battery level monitoring and automatic safety cut-off features.

Sustainability

This solar-powered harvester does not need diesel fuel, thus reducing carbon emissions by 30 tons per unit over its lifetime. When scaled across Rwanda's tea-growing regions, this could reduce the sector's carbon footprint by 25%. It aligns with Rwanda's Green Growth and Climate Resilience Strategy and supports multiple SDGs, including SDG 7 (Affordable and clean energy), SDG 13 (Climate action), and SDG 12 (Responsible consumption and production).

Social Impact

The harvester improves working conditions by reducing physical strain and injury risks for tea workers using traditional manual tea plucking methods. It creates employment opportunities through local manufacturing, maintenance, and training programs. The tea harvesting workforce is made up of 60% women, and the technology empowers workers by easing labour conditions and providing technical training, contributing to gender equality.

Business Model

The business model targets smallholder farmers, cooperatives, and tea estates. It includes cooperative ownership and shared-use models to make the technology accessible and affordable. Financing options such as low-interest loans, government subsidies, and NGO partnerships help ease the initial investment burden. Over the machine's 10-year lifespan, it is expected that the yearly savings add up to around $8,000 in total profit after subtracting the initial cost.

Team 2024-14 — Solar-Powered Grain Storage

Amahoro Uwase Joella, Igihozo Irene Robert, Ndisanze Nkwaya Bohneur, Niyonzima Albert, Turizimana Esther

Theme: Agriculture

Project Summary

The solar-powered grain storage project aims to address the critical issue of post-harvest losses in Rwanda by providing an innovative and sustainable storage solution. Using solar energy, IoT, and AI for real-time monitoring, the storage system maintains optimal conditions for grain preservation, reducing spoilage and improving food security.

Innovation

The design combines renewable energy with advanced monitoring technologies in an affordable, modular, wooden storage design. IoT sensors and AI analytics proactively monitor temperature, humidity, and grain quality in real-time and adjust the conditions to maintain optimal storage environments. The use of local materials and community-level fabrication creates an affordable, accessible and scalable solution for rural farmers.

Sustainability

By using solar energy and natural locally available materials, the system minimises reliance on non-renewable energy, aligning with circular economy principles and reducing the environmental impact of carbon emissions. The system reduces the need for and impact of repeat grain production cycles, leading to fewer wasted resources. The project aligns with several SDGs, including SDG 1 (No poverty), SDG 2 (Zero hunger), SDG 7 (Affordable and clean energy), SDG 8 (Decent work and economic growth), and SDG 13 (Climate action).

Social Impact

The storage system allows farmers to store grain and sell their crops at better market prices, stabilising their income. It creates job opportunities in installation, maintenance, and operation, and increases food security and rural resilience, empowering local communities.

Business Model

Targeted at smallholder farmers and cooperatives, the business model includes flexible payment options such as rent-to-own financing as well as NGO support, and scalable deployment ensuring accessibility and scalability. The growth strategy includes local manufacturing, field testing, and awareness and training programs.

Team 2024-17 — IoT Solar-Powered Fishpond Aerator

Iradukunda Cedrick, Mbeshejwehonayo Elisa, Mugisha Didier Bonheur, Niyomugabo Benjamin, Zachariah Assouman

Theme: Other

Project Summary

This project addresses the challenge of maintaining optimal oxygen levels in fishponds, crucial for aquaculture productivity. The IoT solar-powered fishpond aerator uses solar energy and smart technology to provide efficient, uninterrupted aeration. Key innovations include floating solar panels, sun-tracking mechanisms, real-time sensors, and hybrid energy storage. This system enhances water quality and fish health, boosts productivity, and reduces losses, especially benefiting small-scale and rural farmers. It also supports environmental sustainability by cutting emissions and reducing water evaporation, aligning with several SDGs.

Innovation

The aerator integrates a 120W monocrystalline solar panel and a DC air compressor, reducing energy consumption by 96.8% compared to diesel systems. Sun-tracking technology and IoT sensors optimise energy capture and aeration efficiency. The system includes floating solar panels to minimise land use and reduce pond evaporation, thermal storage to stabilise water temperatures, and modular design for easy repairs and scalability. IoT diagnostics notify farmers via text message 48 hours before potential failures, reducing the downtime of the aerator.

Sustainability

The project promotes sustainability using recycled materials such as aluminium, local assembly, and solar energy. It reduces carbon emissions by 99% per pond and supports Rwanda's emissions reduction targets. The system's lifecycle environmental impact is minimised through recycling partnerships to train technicians in safe recycling, and efficient resource use.

Social Impact

The aerator improves quality of life for fish farmers by reducing costs, increasing income, and improving health outcomes. It creates employment opportunities in manufacturing, maintenance, and related sectors. The project prioritises inclusivity, offering microloans and training programs for women and other marginalised groups.

Business Model

The business model targets smallholder farmers and commercial farms, offering affordable lease-to-own, pay-as-you-go, and cooperative leasing options. The growth plan includes pilot deployments, regional expansion, policy advocacy, and market dominance. The project aims to scale across Rwanda and East Africa, capturing significant market share and achieving substantial revenue and environmental benefits.

Team 2024-21 — Solar Water Purification System Using UV-LED Lamps

Celine Njoma, Janet Rudo Chapunza, Liberty Sachiwo, Simbarashe Jonasi, Walter Moyosvi

Theme: Water and sanitation

Project Summary

The solar water purification system using UV-LED lamps aims to address water-related challenges in Gwanda, Zimbabwe. The system uses solar energy to power UV-LED lamps, which disinfect water by neutralizing harmful pathogens. This approach provides clean drinking water to communities, reducing the prevalence of waterborne diseases and improving public health. The system is designed to be efficient and cost-effective.

Innovation

The system uses UV-LED lamps to neutralise bacteria, viruses, and protozoa, ensuring water safety without chemical treatments. The system monitors real-time water quality and controls energy to prioritise UV-LED lamp power during low sunlight conditions. The design minimises energy waste and operational downtime and offers a scalable solution for rural areas.

Sustainability

The use of solar energy and UV-LED technology reduces greenhouse gas emissions and environmental impact compared to alternatives, estimated at 1kg of CO2 per household per day. It aligns with several SDGs, including SDG 6 (Clean water and sanitation), SDG 7 (Affordable and clean energy), and SDG 13 (Climate action). The system's energy-efficient design and use of eco-friendly materials contribute to long-term environmental sustainability.

Social Impact

The system improves access to clean water, reducing the incidence of waterborne diseases and healthcare costs. It enhances education and economic empowerment by reducing the time spent on water collection, particularly for women and children. The project supports social equity and inclusion, community development, and environmental awareness through training and education programs.

Business Model

The business model targets 168 households in Gwanda town, a rural and semi-arid area in Zimbabwe. Revenue streams include the sale of clean drinking water at affordable prices. Microfinancing options, and prepaid payment models will be offered. The projections estimate a consumer price of $0.13 per bottle, more affordable than the cost of 500ml drinking water in local shops, ranging from $0.25 to $0.50. The growth plan involves prototype development, pilot testing, partnerships with NGOs and local governments, and scaling up manufacturing and distribution.

Team 2024-23 — Solar DC-Powered Induction Cooker

Chikwanah Ngoni, Chitambira Tinotenda B, Mativenga Abnezary

Theme: Cooking

Project summary

The solar DC-powered induction cooker aims to provide a sustainable and efficient cooking solution for rural households in Zimbabwe, where access to electricity is limited. Utilising solar panels and a battery bank, the cooker can operate even at night, reducing pollution and improving health outcomes by eliminating the need for traditional cooking methods that rely on firewood.

Innovation

The cooker integrates solar power with DC induction technology, eliminating the need for AC-to-DC conversion. This reduces the number of electronic components, simplifying the design and manufacturing process. The system is highly efficient, consuming significantly less energy compared to LPG and electric stoves.

Sustainability

The project aligns with several SDGs, including SDG 7 (Affordable and clean energy), SDG 3 (Good health and well-being), and SDG 13 (Climate action). It promotes environmental conservation by reducing deforestation and greenhouse gas emissions.

Social Impact

The cooker improves health by reducing indoor air pollution and respiratory diseases. It also enhances economic empowerment by saving costs on fuel and creating job opportunities in the production and maintenance of the cookers.

Business model

The business model targets rural and peri-urban communities, with potential market expansion to other sun-rich regions in sub-Saharan Africa. It includes cooperative purchasing, rental models, and pay-as-you-go systems to improve accessibility for low-income households.

Team 2024-24 — Solar Radiation Refrigerator (Sorad Fridge)

Otto Murapa, Tanyaradzwa Sango

Theme: Refrigeration

Project Summary

The solar radiation refrigeration system, named Sorad Fridge, leverages solar energy to provide refrigeration for small-scale farmers in rural Zimbabwe. The system integrates Peltier devices and absorption chillers to enhance energy efficiency and environmental sustainability. It aims to address the challenges of unreliable electricity supply and high costs associated with conventional refrigeration methods.

Innovation

The hybrid refrigeration system combines Peltier devices and absorption chillers, using solar radiation as the primary energy source. This integration increases energy conversion efficiency and provides effective cooling. The system features modular design for easy assembly and maintenance and flexible payment models to enhance affordability.

Sustainability

The Sorad Fridge promotes sustainable practices by utilising solar energy, reducing greenhouse gas emissions, and minimising reliance on fossil fuels. It aligns with several SDGs, including SDG 7 (Affordable and clean energy) and SDG 13 (Climate action).

Social Impact

The project aims to improve the quality of life for rural communities by providing reliable refrigeration for food and medicine storage. It fosters job creation, supports local manufacturing and training opportunities, and ensures inclusivity through affordability and ease of use.

Business Model

The target audience includes small-scale farmers in rural Zimbabwe. The business model involves partnerships government and agricultural organisations. It also includes flexible payment schemes including financing, leasing, and pay-as-you-go options. It also has plans to scale, involving increased storage capacity and creating infrastructure for mass production.

Team 2024-25 — Hybrid Solar Water Purification Syste

Chiremba Chessmore, Mikombe Rugare, Pswarai Simbarashe, Zimudi Tadiwanshe

Theme: Water and sanitation

Project Summary

The hybrid solar water purification system aims to provide clean drinking water to off-grid rural communities in Zimbabwe. The system combines solar thermal heating with solar-powered DC heating elements to distil water, ensuring a reliable and eco-friendly purification process free of chemicals. This innovative solution addresses the critical need for safe drinking water, reducing waterborne diseases and improving public health in underserved areas.

Innovation

The system integrates solar thermal and electrical energy to heat water, utilising a steam pipeline isolation system to maintain steam purity. It features sensors for water level and temperature monitoring, ensuring efficient operation. The design is compact, user-friendly, and operates entirely off-grid, making it suitable for remote areas. The use of recycled materials and low-cost components enhances affordability and accessibility. The estimated lifespan of this system is 10 to 15 years.

Sustainability

The project promotes environmental sustainability by using renewable solar energy and eliminating the need for chemical treatments. The system reduces greenhouse gas emissions and environmental impact, contributing to long-term sustainability. It aligns with several SDGs, including SDG 6 (Clean water and sanitation), SDG 7 (Affordable and clean energy), and SDG 13 (Climate action).

Social Impact

The system improves access to clean water, reducing the incidence of waterborne diseases and healthcare costs for the community. It enhances education and economic empowerment by reducing the time spent on water collection, particularly for women and children. The project supports social equity and inclusion, community development, and environmental awareness through training and education programs.

Business Model

The business model targets rural off-grid communities and urban areas in regions facing water shortages in Zimbabwe. Manufacturing could take place in small-scale community workshops, where villagers are trained to assemble components. Local sourcing of components makes the solar water purification system more affordable since it reduces transportation and import costs. The business plan includes flexible payment options offered to accommodate a greater population, including leasing arrangements, pay-as-you-go and instalment plans.

Team 2024-28 — Solar-Powered Food Dehydrator with Smart Moisture Control

Faria Afrin Khan, Md. Fardous Mahmud Fahim, Samiul Hasan

Theme: Agriculture

Project Summary

The solar-powered food dehydrator with smart moisture control is designed to address food spoilage issues in Bangladeshi villages by providing a clean, efficient, and reliable method for drying food. The system uses solar energy to dry food quickly and hygienically, even during cloudy days or at night, by utilising stored solar energy. It is tailored for smallholder farmers to preserve crops like chili, mango, turmeric, and leafy greens, thereby reducing waste and increasing income.

Innovation

The system integrates solar collectors, a drying chamber, battery storage, and smart moisture control using sensors and an Arduino microcontroller. It features a modular design for local assembly and repair and includes real-time water quality monitoring sensors. It features temperature and humidity sensors that automate the drying process, ensuring consistent quality and energy efficiency.

Sustainability

The system is powered entirely by renewable solar energy, significantly reducing greenhouse gas emissions compared to traditional fuel-based dryers. The project supports SDGs including SDG 7 (Affordable and clean energy), SDG 2 (Zero hunger), and SDG 13 (Climate action) by reducing food waste, promoting sustainable farming practices, and utilising renewable energy. The materials used are recyclable or biodegradable, and the system is designed to be energy efficient.

Social Impact

The dehydrator improves food security by extending the shelf life of agricultural products, reducing post-harvest losses, and increasing farmers' incomes. It supports gender equity by reducing the workload traditionally handled by women.

Team 2024-30 — Solar-Powered Milling Machine

Chukwuemeka Ani, Ejima Enemona Elijah, Joy Chiezie, Nonso Onwuazor, Overcomer Chiedozie

Theme: Agriculture

Project summary

The solar-powered milling machine aims to provide a sustainable and efficient solution for grain milling in rural Nigeria, where access to electricity is limited. Utilising solar energy, the machine reduces reliance on fossil fuels, lowers operational costs, and minimises environmental impact. It is designed to improve food security, reduce post-harvest losses, and enhance the livelihoods of small-scale farmers.

Innovation

The milling machine integrates a DC motor powered by solar panels, eliminating the need for fossil fuels. It features improved speed and protective covers to enhance performance and durability. The use of locally sourced materials and recyclable components further reduces costs and environmental impact.

Sustainability

The project aligns with several SDGs, including SDG 2 (Zero hunger), SDG 7 (Affordable and clean energy), SDG 8 (Decent work and economic growth), SDG 12 (Responsible consumption and production), and SDG 13 (Climate action). It promotes sustainable practices by reducing greenhouse gas emissions and utilising renewable energy.

Social impact

The machine improves food security, health, and income generation for rural communities. It creates job opportunities in production, maintenance, and operation, empowering local workers and supporting rural development.

Business model

The business model targets small-scale farmers, cooperatives, and milling businesses in rural areas. The secondary markets include NGOs, and government programs and humanitarian organisations focused on food security. It includes credit sales and pay-as-you-go options to improve accessibility for low-income households.

Team 2024-32 — Solar-Powered Drone for Medical Supply

Bharath Kumar Y, Kavin Kumar S, M Bhavani, Padmini A, Sri Darshni Thayalan

Theme: Healthcare

Project Summary

The solar-powered medical supply drone is designed to deliver critical medical supplies to remote and underserved regions using solar energy. The drone features a lightweight, single-propeller design and can carry up to 3 kg of medical supplies. It operates autonomously with GPS-based navigation and is equipped with high-efficiency solar panels and a backup battery.

Innovation

The drone utilises solar power for propulsion and onboard electronics, eliminating the need for grid-connected electricity or fuel. It features autonomous flight control, real-time GPS tracking, and a modular medical compartment for safe transport of temperature-sensitive supplies.

Sustainability

The drone operates solely on solar energy, reducing carbon emissions and promoting energy independence. It supports SDG 3 (Good health and well-being), SDG 7 (Affordable and clean energy), SDG 9 (Industry, innovation and infrastructure), and SDG 13 (Climate action).

Social Impact

The project enhances healthcare access in remote areas by providing timely and reliable delivery of medical supplies. It improves emergency response, supports disaster resilience, and empowers rural communities to effectively access medicine through innovative technology.

Business Model

The business model targets rural health networks, NGOs, and disaster relief agencies. It involves scalable and modular design, cost-effective components, and potential for future enhancements such as AI-based route optimisation and swarm drone technology.

Team 2024-33 — Solar-Powered DC Refrigeration System

B Likitha, B Sri Durga Prasad, D Meghana, K Abhinav, V Sai Kiriti

Theme: Refrigeration

Project Summary

The solar-powered DC refrigeration system aims to provide eco-friendly and energy-efficient refrigeration in off-grid areas. The refrigeration unit employs Peltier modules for cooling, making it more energy-efficient and maintenance-free compared to traditional DC compressors. The system is designed to operate in off-grid environments, providing stable cooling within the 0—10°C range, and suitable for storing perishable items such as food and medicines.

Innovation

The system integrates solar power with advanced thermoelectric cooling technology using Peltier modules, each equipped with aluminium heat sinks and cooling fans for handling the heat dissipation. Using solar panels, a maximum power point tracking charge controller, and battery storage, the system ensures continuous operation even in low sunlight conditions. Key features include a barcode scanner for logging product information and expiry dates, and a smart alert system that notifies users two days before an item's expiration.

Sustainability

The appliance uses renewable solar energy and eliminates the need for harmful refrigerants or compressor-based systems. This reduces greenhouse gas emissions and minimises environmental impact. It aligns with several SDGs, including SDG 3 (Good health and well-being), SDG 7 (Clean energy), SDG 9 (Industry, innovation, and infrastructure), SDG 13 (Climate action), and SDG 12 (Responsible consumption and production).

Social Impact

The system improves access to reliable refrigeration, reducing food spoilage and healthcare costs. It has the potential to enhance public health if used for the storage of vaccines and medicines. The project supports community development through training programs and employment opportunities in local assembly and maintenance of the appliance.

Business Model

The business plan will develop an IoT integrated system to allow remote monitoring and use of machine learning to predict expiry based on storage conditions and usage patterns. The project will scale the design for larger cold storage units and community-based shared refrigeration systems. The target market is rural, remote and underserved communities off-grid areas.

Team 2024-34 — Solar-Powered Smart Irrigation and Fertilizer System

Arun S, J Beaula Jenefa, Nalla Suneela, Thummala Nithin Reddy, V Siva Rami Reddy

Theme: Agriculture

Project Summary

This project presents a comprehensive, solar-powered smart irrigation and fertilisation system designed to address the pressing challenges of water scarcity, inefficient irrigation practices, and high energy costs in agriculture. Targeted at small and medium-scale farmers in off-grid or weak-grid rural areas, the system integrates renewable energy, IoT-based environmental sensing, and AI-driven automation to optimise water and nutrient delivery to crops. By leveraging real-time data on soil moisture, temperature, humidity, and nutrient levels, the system ensures precise irrigation and fertilisation, thereby improving crop yields, conserving resources, and reducing operational costs.

Innovation

The system includes multiple features including automated precision irrigation, AI-powered pest detection, nutrient management and self-maintenance mechanisms. The use of IoT, AI and smart automation makes the design more reliable, adaptive and efficient than other solutions.

Sustainability

The project supports SDGs including SDG 6 (Clean water and sanitation), SDG 7 (Affordable and clean energy), and SDG 13 (Climate action) by promoting efficient water use, reducing reliance on fossil fuels, and minimising greenhouse gas emissions. The system is designed for off-grid operation, ensuring sustainability and energy independence.

Social Impact

The system improves quality of life by reducing manual labour, increasing crop yields, and providing economic opportunities. It supports sustainable farming practices, reduces electricity costs, and promotes technological access in rural areas.

Business Model

The business model targets small and medium-scale farmers, offering a cost-effective and scalable solution. The growth plan includes a phased deployment strategy beginning with pilot installations, followed by regional expansion through partnerships with NGOs, local governments, and agri-tech startups. The system is offered through flexible financing options such as pay-as-you-go and microfinancing, making it accessible to smallholder farmers.

Team 2024-36 — Development of a Portable Foetal Heart Monitoring Device

Muhammad Sajid Hossain, Samara Islam, Tasfia Hasan Faiza

Theme: Healthcare

Project Summary

This project presents a low-cost, portable foetal heart monitoring device designed to improve prenatal care in rural and underserved areas. The system uses a stethoscope with an electret microphone to capture foetal heart sounds, which are processed using signal decomposition techniques (Empirical Mode Decomposition and Wavelet Transform) to isolate foetal heart rates. The device is compatible with smartphones and laptops, enabling easy data recording and transfer. It supports offline use and can be powered by solar setups, making it suitable for off-grid environments.

Innovation

The innovation lies in the integration of simple, accessible hardware with advanced signal processing algorithms to extract foetal heart signals. The use of a shielded cable allows for effective noise reduction and signal isolation. The device also supports telemedicine and remote diagnostics, and the project generates a unique raw foetal PCG dataset for future research and AI development.

Sustainability

The project aligns with SDG 3 (Good health and well-being) and SDG 10 (Reduced inequalities). It promotes sustainable healthcare practices by reducing energy consumption and providing accessible and affordable prenatal care.

Social Impact

By lowering the cost and complexity of foetal monitoring, the device empowers rural clinics and expectant mothers with better access to prenatal care. It promotes early diagnosis, reduces travel and waiting times, and supports telemedicine. The project also raises awareness about foetal health and contributes to building a valuable dataset for future medical research and AI applications. Its minimal component requirements and offline functionality further enhance its sustainability and accessibility in low-resource settings.

Business Model

The business model includes both business to business (B2B) and business to company (B2C) strategies. B2B involves partnerships with clinics, hospitals, NGOs, and government programs, while B2C targets direct sales through online platforms and pharmacies. Revenue streams include hardware sales, software subscriptions, accessory sales, and licensing of the raw foetal PCG dataset for research and development.

Team 2024-39 — Solar-Powered Electric Boat

Brishti Dhar, Md. Parvez Sultan, Md. Shahariar Parves, Md. Yasin Altaf, Sajid Zafry Ahsan

Theme: E-mobility

Project Summary

The solar-powered electric boat is designed to replace traditional diesel-powered boats, reducing operational costs and the effects of harmful gas emissions on people and the environment. The boat uses solar energy to power an electric motor, providing a sustainable and cost-effective solution for water transportation.

Innovation

The boat integrates solar panels, an intelligent battery management system, and a BLDC motor for efficient propulsion, maximising performance and efficiency. A modular solar grid provides battery charging and the boat display unit provides real time data on the battery status, boat speed, and environmental conditions. The boat design is optimised to have a low drag and weight, enhancing the range and speed while minimising energy use. It features modular design, optimal energy management, and advanced control systems to enhance performance and reliability.

Sustainability

Using solar panels and efficient motors, the system operates without burning fossil fuels, reducing carbon emissions and noise pollution, and limiting negative impacts on marine ecosystems compared to diesel boats. The project uses recyclable materials where possible as well as products with long life spans. It supports SDG 7 (Affordable and clean energy), SDG 11 (Sustainable cities and communities), and SDG 13 (Climate action).

Social Impact

The project aims to improve air quality, reduce noise pollution, and provide affordable transportation for communities reliant on waterways. It also aims to reduce the economic strain on fisher people and boat operators, by reducing operational costs and maintenance needs. It creates economic opportunities through job creation in manufacturing, maintenance, and tourism.

Business Model

The business model includes partnerships with local distributors and suppliers and targets recreational boaters, tourism operators, water transport services, and research institutions. It involves establishing relationships with customers to increase customer satisfaction, as well as offering them direct sales and payment plan options. Marketing strategies include digital outreach such as social media and television.

Team 2024-40 — Solar-Powered Greywater Recycling System for Sustainable Water Management in Uganda

Kalwanyi Richard, Nassiwa Catherine, Sserunjogi Ahmed Mansul

Theme: Water and sanitation

Project Summary

The solar-powered greywater recycling system aims to address water scarcity and inadequate sanitation in rural communities and informal settlements in Uganda. The system combines reverse osmosis technology with solar energy to treat greywater and render it safe for non-potable reuse such as irrigation, toilet flushing, and cleaning. This innovative solution leverages Uganda's abundant solar energy to provide an efficient, affordable, and environmentally sustainable method for water reuse, reducing reliance on fresh water sources and minimising environmental pollution.

Innovation

The system integrates solar PV power with advanced greywater-wastewater from non-toilet domestic activities treatment technology. Key components include a greywater collection tank, pre-treatment unit, reverse osmosis membrane, solar PV panels, battery bank, treated water storage tank, and distribution system. The design is modular, compact, and optimised for energy efficiency, making it suitable for both off-grid and urban communities. Optional smart add-ons include water quality sensors, flow meters, and GSM modules for remote monitoring. This appliance is easily customisable to household or institutional uses.

Sustainability

The project promotes environmental sustainability by reducing freshwater demand, preventing greywater pollution, and cutting carbon emissions through solar energy use. It aligns with several SDGs, including SDG 6 (Clean water and sanitation), SDG 7 (Affordable and clean energy), SDG 11 (Sustainable cities and communities), and SDG 13 (Climate action). The system's modular design ensures scalability and adaptability across various social and economic contexts.

Social Impact

The system improves access to clean water, enhances sanitation, and reduces the incidence of waterborne diseases. It supports community involvement, local manufacturing, and capacity-building through training programs for system operation and maintenance. The project empowers local users, promotes hygiene, and creates green jobs, contributing to socio-economic development and environmental sustainability.

Business Model

The business model targets households, schools, car wash and laundry businesses, and small-scale farmers. The project emphasises community involvement, local manufacturing, scalability, and sustainability. With proper partnerships and capacity-building, this project has the potential to make a lasting impact across Uganda and similar regions.

Team 2024-41 — Low-Cost Solar-Powered Water Carrier

Daniel Gatward, Ho Lun Wong, Mihaela Alexia Hostiuc

Theme: Water and sanitation

Project Summary

The low-cost solar-powered water carrier is designed to alleviate the physical burden and time costs associated with water transportation in rural Ethiopia. The system integrates electric locomotion, real-time station data reception, and a user-friendly interface into a familiar cart-like format, significantly reducing the physical strain involved in water transportation, especially across hilly terrain.

Innovation

The carrier features an electric motor manually activated by user input or automatically when detecting an upward slope, based on accelerometer data. It uses LoRa communication for real-time updates on water station status and includes a low-tech display for non-literate users. The system is modular, allowing for local assembly and repair, and operates entirely using solar power.

Sustainability

The carrier relies exclusively on renewable energy, reducing greenhouse gas emissions and operational costs. It uses recyclable materials and a modular design to minimise environmental impact and support long-term usability. The system also promotes sustainable water use by integrating with IoT water stations to manage demand-side water management.

Social Impact

The carrier reduces the time and physical strain of water collection, improving health and safety, particularly for women and girls. It supports local employment through manufacturing and maintenance, and its inclusive design ensures accessibility for users with varying literacy levels and physical abilities.

Business Model

The business model aims to be affordable and accessible to end users, leveraging public-private partnerships and using financing models such as pay-pre-use and shared ownership. The growth plan includes a phased deployment plan with pilot project. The design is modular, allowing for local repair, and the manufacturing and deployment will be adapted to local contexts.

Team 2024-42 — Low-Cost Solar-Powered IoT Water Station

Essa Abikar, Wei Cheng, Zhiyi Zhuang

Theme: Water and sanitation

Project Summary

The low-cost solar-powered IoT water station aims to provide a sustainable and efficient solution for water resource management in rural areas. Utilising solar energy and IoT technology, the system monitors water levels and ensures continuous operation, and is suitable for use in off-grid settings.

Innovation

The water station integrates solar panels, batteries, and a low-power controller like ESP32 with deep-sleep functionality. It uses ultrasonic sensors to measure water levels and LoRa modules for data transmission. The system is designed to be cost-effective, modular, and easy to maintain.

Sustainability

The project aligns with SDG 6 (Clean water and sanitation), SDG 7 (Affordable and clean energy), and SDG 13 (Climate action). It promotes environmental sustainability by reducing the need for manual water checks and minimising greenhouse gas emissions.

Social Impact

The water station improves access to clean water, reduces the physical burden on women and children, and creates local employment opportunities. It enhances community health and well-being by ensuring a reliable water supply.

Business Model

The business model targets NGOs, local water authorities, and community-based water management teams. It includes pilot deployments, user training, and partnerships to scale the solution. The system's affordability and ease of use make it accessible to underserved communities.

Team 2024-44 — Irrigation Solar System

Arame Bousso, Sira Oumou Khairy Diallo, Vanessa Deffo, Yacine Ba

Theme: Agriculture

Project Summary

The project aims to design an automated irrigation system powered by solar energy to improve efficiency, reduce costs, and ease the workload on farmers in Equatorial Guinea compared to the use of other irrigation systems. The system includes solar panels, a submerged pump, motorised valves, and a web application for remote monitoring and control.

Innovation

The irrigation system integrates solar power with automated drip irrigation, using motorised valves and a microcontroller for precise water delivery. It features a user-friendly mobile application for remote control and real-time monitoring.

Sustainability

The system promotes sustainable agriculture by reducing water waste, conserving energy, and minimising environmental impact. It supports SDG 2 (Zero hunger), SDG 6 (Clean water and sanitation), and SDG 7 (Affordable and clean energy).

Social Impact

The project improves the quality of life for farmers by reducing operational and water use costs, reducing manual labour, enhancing crop health, and increasing productivity. It fosters community development through training programmes and job creation in system maintenance and operation.

Business Model

The target audience includes small-scale farmers in Equatorial Guinea. The business model involves partnerships with local agricultural cooperatives to gather feedback and tailor the system as well as flexible payment schemes and scalability plans to expand the system to larger farms and different crop types.

Team 2024-46 — Affordable Smart Solar-Powered Poultry Feeding System (SmartFeeder)

Buyungo John Baptist, Lubega Juma

Theme: Agriculture

Project Summary

The SmartFeeder system is an innovative, solar-powered automatic poultry feeding and watering solution. This system tackles challenges in small and medium-scale poultry farming in Uganda such as inconsistent feeding, food wastage, and labour intensity. By combining smart automation with energy-efficient technology, SmartFeeder empowers farmers to control feeding remotely through a smartphone or manually via a switch, even in off-grid settings. The system ensures regular and accurate feed and water delivery, improving poultry health, reducing labour costs, and boosting overall productivity.

Innovation

The SmartFeeder integrates solar power with advanced feeding technology, energy saving features, and cost-effective local manufacturing, offering a scalable solution that addresses both economic and technical challenges in poultry farming. This design allows for more efficient movement for birds, less clutter, and easier management within the poultry house.

Sustainability

The system promotes environmental sustainability by eliminating the need for diesel fuel, thus reducing carbon emissions. It aligns with several SDGs, including SDG 7 (Affordable and clean energy), SDG 13 (Climate action), and SDG 12 (Responsible consumption and production). The system minimises environmental impact throughout its lifecycle, with recyclable components and guidance for responsible disposal practices.

Social Impact

The system improves working conditions by reducing physical strain and injury risks for poultry workers, many of whom are women. It creates employment opportunities through local manufacturing, maintenance, and training programmes. The technology empowers women by easing labour conditions and providing technical training, contributing to gender equality and economic development in rural communities.

Business Model

The business model targets small to medium farms, and youth-led agribusinesses. It includes cooperative ownership and shared-use models to make the technology accessible and affordable. Financing options such as low-interest loans, government subsidies, and NGO partnerships help ease the initial investment burden. The SmartFeeder's long-term economic benefits, including reduced labour costs and increased yields, ensure a quick return on investment for end users.

Team 2024-48 — Eco Solar Cassava Flash Dryer

Agilo Joyce Ruth, Bananuka Lynnette, Ojok Oscar Brian

Theme: Agriculture

Project Summary

The Eco Solar Cassava Flash Dryer addresses the high post-harvest losses of cassava in Uganda by providing a solar and waste-powered drying solution. The system dries cassava with zero fuel costs, significantly reducing losses and boosting incomes for smallholder farmers.

Innovation

The dryer uses a hybrid system powered by solar panels and cassava waste combustion, achieving a 99.6% reduction in energy use compared to kerosene dryers. It features an auto-switching mechanism for reliability and a modular design for easy transport and assembly.

Sustainability

The dryer minimises environmental impact by using locally sourced materials and reducing greenhouse gas emissions. It aligns with multiple SDGs, including SDG 7 (Affordable and clean energy), SDG 1 (No poverty), SDG 2 (Zero hunger), SDG 13 (Climate action), and SDG 12 (Responsible consumption and production).

Social Impact

The dryer enhances food security, reduces health risks, and creates job opportunities. It supports gender equity by freeing up time for women and providing economic opportunities. The system is inclusive, with controls and manuals available in local languages.

Business Model

The business model includes dryer sales, a processing facility, and a drying service. The growth plan involves prototype finalisation, pilot deployment, design refinement, and scaling production. The unique value proposition is ‘affordable, sustainable drying for high-quality cassava’.

Team 2024-49 — Design and Construction of a DC Garri Frying Machine

Felicia Friday Paul-Jazom, Sam-Ogide Adiela, Sunday Boyewa Edema, Uchenna Gregory Mbah, Uwemedimo Uduak Frank

Theme: Agriculture

Project Summary
The solar-powered garri fryer aims to modernise the traditional garri frying process by integrating solar energy and DC motor technology. This innovation addresses the inefficiencies and health hazards associated with traditional methods, providing a sustainable, efficient, and cost-effective solution for rural farmers.

Innovation
The fryer utilises a DC motor, battery storage, inductive heating elements, and an insulated stainless-steel frying pan with a stirring mechanism. It offers precise temperature control, reduces labour, and eliminates the health risks associated with smoke from firewood. The system is designed for durability and ease of use, making it accessible to smallholder farmers.

Sustainability
The project aligns with several SDGs, including SDG 1 (No poverty), SDG 3 (Good health and well-being), SDG 5 (Gender equality), SDG 7 (Affordable and clean energy), SDG 9 (industry, innovation, and infrastructure), SDG 12 (Responsible consumption and production), SDG 13 (Climate action), and SDG 15 (Life on land). It promotes environmental sustainability by reducing deforestation, pollution, and waste.

Social Impact
The fryer improves productivity, health, and income for rural farmers. It reduces exposure to heat and smoke, enhancing the working conditions for women who are primarily involved in garri processing. The system also supports local job creation and community development.

Business Model
The business model targets smallholder farmers, cooperatives, agro-processors, exporters, food startups, and NGOs. It includes direct sales, partnerships, and awareness campaigns to drive adoption. The growth plan involves scaling production and distribution across key cassava-producing states in Nigeria.

Team 2024-50 — Water Purification Device

Dominic Ogodo, Madu-Chikwendu Crystal, Salam Ridwan, Okechukwu Ochulor, Vincent Okechukwu

Theme: Water and sanitation

Project Summary

The portable solar-powered multi-stage water purification device is designed to provide clean drinking water to rural communities lacking access to safe water sources. The device integrates filtration, UV radiation, electrochemical disinfection, and pH regulation, powered by solar energy and supported by a rechargeable battery system. It aims to reduce waterborne diseases and improve health outcomes in underserved areas.

Innovation

The device combines multiple purification technologies into a compact, portable unit powered entirely by solar energy. It features a modular design for easy deployment and maintenance, ensuring continuous access to portable water in off-grid settings.

Sustainability

The system uses long-lasting filters, recyclable materials and minimises water wastage, supporting the circular economy model. It eliminates the need for wood-burning or fuel-powered boiling, reducing greenhouse gas emissions and deforestation.

Social Impact

The device addresses the fundamental challenge of clean water access in rural areas, reducing the incidence of waterborne diseases and empowering women and children by eliminating the need for their long treks to water sources, freeing time to pursue academic and economic opportunities. It also promotes social well-being and economic productivity.

Business Model

The business model includes direct sales, instalment financing, and institutional partnerships. Replacement parts and maintenance services provide ongoing revenue. Strategic collaborations with NGOs and government agencies facilitate bulk procurement and deployment in larger institutions or communities.

Team 2024-52 — Solar-Powered Sugarcane Juice Extractor Using DC Motors

Aminu Fatima Musa, Sunday Victor

Theme: Agriculture

Project Summary

The solar-powered sugarcane juice extractor aims to provide a sustainable and efficient solution for juice extraction in off-grid areas of Sokoto State, in Northern Nigeria. This innovative machine uses solar energy to power DC motors, addressing the challenges of traditional manual or fossil-fuel-powered extractors used by smallholder farmers. The system leverages renewable energy and locally available materials.

Innovation

The extractor integrates solar photovoltaic technology with a 12V DC gear motor, controlled by an Arduino-based smart controller. Key features include maximum power point tracking charge controllers for increased energy efficiency, stainless steel rollers for hygiene, and a modular design for easy assembly and maintenance. It offers high juice yield with minimal energy consumption and is tailored for off-grid regions.

Sustainability

The project promotes environmental sustainability by using renewable solar energy and recyclable materials. It reduces greenhouse gas emissions by nearly 100% during operation, replacing diesel-powered machines. The system aligns with SDGs including SDG 7 (Affordable and clean energy), SDG 8 (Decent work and economic growth), SDG 13 (Climate action), and SDG 12 (Responsible consumption and production). The use of stainless steel ensures durability and recyclability, minimising environmental impact.

Social Impact

The system improves the quality of life of rural communities by reducing physical strain and increasing productivity for small-scale farmers and vendors. It enhances community nutrition by providing access to fresh, hygienic sugarcane juice. The project generates employment through local manufacturing, maintenance, and distribution networks. It supports economic inclusion, particularly for women and youth, by enabling small juice businesses and promoting gender inclusiveness.

Business Model

The business model targets smallholder farmers, juice vendors, youth entrepreneurs, and women's cooperatives. The business plan includes awareness campaigns, pay-as-you-go models, and vocational training partnerships. The growth plan involves prototype development, pilot testing, user feedback, local partnership building, and full market launch within 12 months.

Team 2024-53 — Solar DC Dryer for Post-Harvest Preservation of Crops

Hiluf Alemu Adihena, Yared Selemon Bogale, Znabu Mehari Gebrezgi

Theme: Agriculture

Project Summary

The solar DC dryer is designed to reduce post-harvest crop losses in off-grid communities, particularly in Tigray, Ethiopia. The system uses solar energy and a passive tracking system to provide a controlled environment for drying crops, improving preservation and reducing losses.

Innovation

The dryer features an external heater assistance mechanism, an improved solar absorber plate and a tracking system. It enables easy temperature and moisture control through sensors and ensures uniform distribution of hot air. This innovative approach improves efficiency, reduces processing time and maintains product quality.

Sustainability

The dryer supports multiple SDGs, including SDG 2 (Zero hunger), SDG 3 (Good health and well-being), SDG 7 (Affordable and clean energy), SDG 8 (Decent work and economic growth), SDG 9 (Industry, innovation and infrastructure), SDG 12 (Responsible consumption and production), SDG 13 (Climate action), and SDG 15 (Life on land). It reduces reliance on fossil fuels and promotes sustainable agricultural practices.

Social Impact

The dryer enhances food security, increases farmers' incomes, and supports women's empowerment. It encourages community ownership and development, creating jobs and supporting local economies.

Business Model

The business model includes individual purchase, cooperative ownership, and drying service provision. The growth plan involves prototype development, pilot deployment, and scaling production. The system is designed to be affordable and locally maintained, ensuring long-term sustainability.

Team 2024-54 — Low-Cost Solar-Powered Neonatal Incubator

Abe Boluwatife Christianah, Abilewa Ayomide Michael, Dhikrullahi Ibrahim Kayode

Theme: Healthcare

Project Summary

The low-cost solar-powered neonatal incubator aims to provide a reliable and affordable solution for neonatal care in low-resource settings. Utilising solar energy, the incubator maintains optimal temperature and humidity levels for newborns, ensuring continuous operation including in off-grid areas.

Innovation

The incubator integrates solar power with advanced control systems, including a PI-controlled heater, ultrasonic humidifier, and sensors for temperature, humidity, and weight. It uses automated monitoring, and features modular, repairable components. It also uses phenolic plywood for durability and thermal insulation, and energy-efficient components like LED lighting. The design emphasises affordability, energy efficiency, and local manufacturability, making it suitable for widespread deployment in resource-limited settings.

Sustainability

The incubator operates on solar DC power, reducing greenhouse gas emissions. It uses durable, recyclable materials like phenolic plywood and modular components for easy repair and long lifespan. Energy-efficient systems and smart controls minimise power use, supporting sustainability and environmental responsibility. The project aligns with several SDGs for example SDG 3 (Good health and well-being), SDG 9 (Industry, innovation, and infrastructure), SDG 10 (Reduced inequalities), and SDG 13 (Climate action).

Social Impact

The incubator improves neonatal care accessibility, especially in rural areas, by providing a cost-effective and reliable solution. It enhances infant survival rates and supports local job creation through manufacturing, maintenance and distribution. By improving neonatal outcomes and reducing healthcare costs, it enhances community health and economic resilience. Training programs and partnerships further support local capacity building.

Business Model

The model includes a one-time purchase option and microfinancing for affordability. The business model includes partnerships with hospitals, clinics, NGOs, and government health initiatives. It focuses on affordability, local manufacturing, and training programs to ensure widespread adoption and sustainability.

Team 2024-55 — Solar Farm Monitoring System

Ayelaagbe Timothy, Olaoti Favour Omotola, Oloyede Elijah

Theme: Agriculture

Project Summary

The solar RFID farm monitoring system aims to address uncontrolled cattle grazing in Nigeria, which leads to farmland destruction and farmer-herder conflicts. The system uses RFID technology and solar power to monitor and regulate livestock movement, improving food production and public safety.

Innovation

The system integrates solar-powered RFID readers and tags to track cattle movement, ensuring energy efficiency and accessibility in rural areas with limited electricity and internet connectivity. It uses text message alerts to notify farmers when animals enter restricted areas.

Sustainability

The system promotes sustainable agriculture by reducing crop losses and preventing food and livestock poisoning. It supports SDG 2 (Zero hunger), SDG 7 (Affordable and clean energy), and SDG 13 (Climate action).

Social Impact

The project aims to reduce conflicts between farmers and herders, improve farmland protection, and enhance community security. The design means farmers with minimal digital know-how can use the technology, increasing its usability. It creates employment opportunities in system installation and maintenance, fostering local development.

Business Model

The business model targets farms experiencing persistent conflicts and private farms looking to control animal grazing. It involves partnerships with government agencies, NGOs, and agricultural cooperatives to subsidise distribution and ensure accessibility for low-income rural farmers.

Team 2024-56 — Automated Solar-Powered Irrigation System for Smallholder Farmers

Ayanyori Olamide, Oluwafemi Emmanuel, Soyinka Enoch

Theme: Agriculture

Project Summary

The solar-powered irrigation system addresses irrigation challenges for smallholder farmers in rural Nigeria, where manual methods lead to water waste and low crop yields. The system uses a solar water pump to fill a raised tank, from which water is distributed via gravity-fed drip pipes based on soil moisture levels detected by tensiometers. Priced at $200/unit with a pay-as-you-go model, the system ensures affordability.

Innovation

The irrigation system integrates solar power with advanced irrigation technology. Key components include a 100W solar panel, a DC pump, a raised tank with a float valve, tensiometers for soil moisture monitoring, an Arduino Nano microcontroller, and a SIM900A GSM module for text message alerts. The system is designed to be cost-effective, with materials locally sourced and easy to maintain, ensuring affordability and sustainability. Pilot tests with 20 farmers are expected to show 30% water savings, 20% yield increases, and 0.15 kWh/1000L energy use, compared to 2 kWh for diesel pumps.

Sustainability

The system promotes environmental sustainability by using renewable solar energy and reducing water waste. It aligns with SDG 2 (Zero hunger), SDG 7 (Affordable and clean energy), SDG 8 (Decent work and economic growth), and SDG 13 (Climate action). The system's zero-emission operation and recyclable components minimise environmental impact, while its durability ensures long-term sustainability.

Social Impact

This system improves quality of life by automating irrigation, saving farmers four — six hours daily and reducing physical strain, particularly for women and the elderly. The system's simplicity ensures accessibility for low-literacy users. Training programmes will create technician jobs, boosting rural employment.

Business Model

The business model targets smallholder farmers in Nigeria, particularly in the dry northern and central regions. The system's estimated cost is $200, and a pay-as-you-go model ($20/month for 10 months) makes it affordable. Partnerships with NGOs and government renewable energy programmes will support funding and distributing the units. The system's modular design scales to various farm sizes, and local materials and simple technology simplify logistics.