SOLAR INDUCEed domestic clean efficient cooking and refrigeration for off-grid applications in Africa

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Spain

LEAP-RE

Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

First Pillar1 Projects Meeting

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The LEAP-RE project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

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Consortium

SOLAR INDUCE consortium comprises 7 partners from 2 European countries (UK and Spain), 2 African countries (Egypt and South Africa), with contributing agencies, and 2 African partners from Nigeria that don't have contributing agencies.

There is strong industry/commercial leadership and involvement in this consortium.

SOLAR INDUCE includes industry leader (COPRECI) and technological SME (SPG) with research performing capacity to contribute to technology push.

They are capacitated to contribute to the design and manufacturing effort and are also committed to commercialisation.

Each industry partner has clear expectations and commitments towards commercially using the results of this project in their businesses. This has been important for each industry partner for committing to co-funding this project. This commitment is a solid starting platform towards ensuring the exploitation of the results post-project.

Aim of the project

To develop and demonstrate innovative high-performance and cost-effective **solar off-grid cooking and refrigeration solutions** in African rural and remote communities, focusing upon **local** content of **manufacturing**, **materials**, and local population **employability**. The proposed technology will be **laboratory tested and** undergo **demonstrations** at an allocated site in Africa.

Relevance vs MARs

MAR 6 – Innovative solutions for priority domestic uses (clean cooking and cold chain)

In **Africa**, **700 million people lack access to clean cooking** [1]. In addition, in Africa nearly **40% of food perishes** before it reaches the consumer [2]. It directly impacts the livelihoods of many households and the local economy, on health centers, schools, and food production and storage.

[1] Access to clean cooking – SDG7: Data and Projections – Analysis – IEA, 2020.
[2] Food and Agriculture Organisation of the United Nations, 2020.

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Project coordinator:

- *Jose Ignacio Mujika*, COPRECI S Coop (**Spain**).

Project partners:

- *Sarah Khalil*, The British University in Egypt (**Egypt**).
- *Raymond Taziwa*, Walter Sisulu University (**South Africa**).
- *Patricia Popoola*, Tshwane University of Technology (**South Africa**).
- *Onyedika Aneke*, S&P Global Resources Nigeria Limited (**Nigeria**).
- *Paul Nnamchi*, Enugu State University of Science and Technology (**Nigeria**).
- *Ulugbek Azimov*, University of Northumbria (**United Kingdom**).

[1] Access to clean cooking – SDG7: Data and Projections – Analysis – IEA, 2020.
[2] Food and Agriculture Organisation of the United Nations, 2020.

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Key challenges addressed by the project

1. *To develop a system for domestic cooking that will be powered by free solar energy.*

2. *To develop an effective refrigeration cycle powered by solar energy during the day and through passive refrigeration overnight.*

Expected results

- *Helping to protect women and children form collecting biomass for cooking and becoming ill due to respiratory problems.*
  - *Pilot in Nigeria*

- *The main aim of this innovation will be to reduce the actual food losses (by more than 80%), increase food producer/retailer incomes (by 30%) and reduce food spoilage and poisoning.*
  - *Pilot in Egypt*

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Key challenges addressed by the project

1. *To develop a green cooking solution based on induction technology that is more efficient, more economical and more robust, to enable its powering by solar panels and its deployment in rural settings in Africa.*

Expected results

- *A fully functional induction cooker with a 10 % efficiency improvement*
- *A cookware retrofit solution to enable the use of traditional cookware.*
- *A local demonstration pilot in Nigeria to assist in the dissemination and promotion of this technology.*

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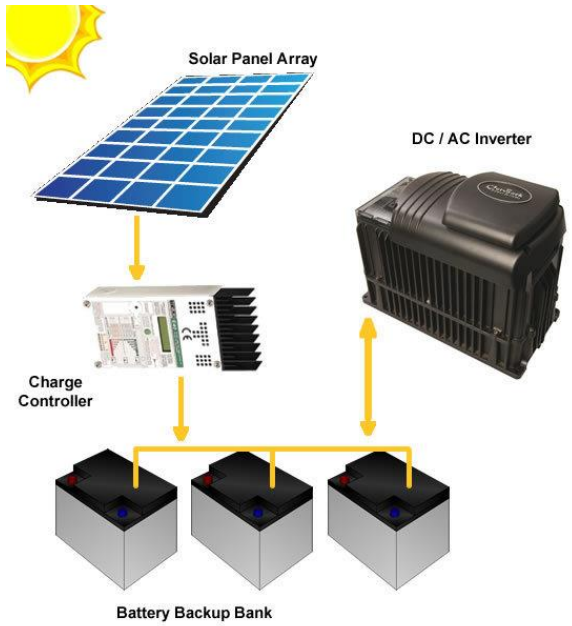
Piloting:



Clean cooking

Milestone:

- Demonstrate solar induction cooking system
- Ako-Nike community (Nigeria)

COPRECI · ESUT · Tshwane University of Technology · WSU · GLOBAL RESOURCES NIG. LTD.

Refrigeration system

Milestone:

- Solar refrigeration based on natural hydrogels from local mucilage (Cacao and Dika nut)
- Demonstration in Egypt

Northumbria University NEWCASTLE · ESUT · BUE · Tshwane University of Technology · WSU · GLOBAL RESOURCES NIG. LTD.

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Expected outcomes in case of success of the project (2030)

1. *Economic:*

1. *SOLAR INDUCE is estimated to create more **than 30 direct jobs** directly on the pilot sites.*
2. *It will also create **jobs indirectly** by increasing business operation hours through income generation from the energy solutions, energy cost savings or less time spent on cooking.*
3. *By assisting communities to expand electricity-powered productive activities, a virtuous cycle will be created in which electricity consumption will increase alongside increasing household incomes.*
4. *The final element of this virtuous cycle is that increased consumption will eventually allow companies to reduce electricity prices.*
5. *The project will **help communities expand** renewable electricity-powered **cooking activities**, which will reduce expenses for collecting charcoal and firewood, as free solar energy will always be available.*

2. *Environment:*

1. *SOLAR INDUCE will make an impact on **reducing GHG** emissions, as a result of the replacement of inefficient fuel production and consumption, by renewable solar energy,*
2. *It will help **preventing forest degradation** and deforestation due to fuel collection and production,*
3. *and **improving agricultural productivity** as a result of preventing habitat degradation and combustion of dung as fuel.*

3. *Creation of new market opportunities for both EU and African companies on the African continent*

1. *By the provision of electricity and electrical equipments, SOLAR INDUCE will lay the ground for the development of many electricity-powered cooking businesses such as for agriculture (food dryers, incubators, etc.), food industry (catering, restaurants, community dining, etc.), and social (education, health devices, etc.).*
2. *In addition, the mini-grid and off-grid solar systems as well as induction cooking will pave the way for partnerships **between local and international firms.***

Which are main risks of failure during project implementation ?

1. *Receiving authorisation for demonstration will take more time and will put the project at risk*
2. *Security clearances of some countries may delay the timings*
3. *Technical risks:*
    1. *Induction efficiency, suitability of materials, electromagnetic matching.*
    2. *Optimisation of absotion refrigeration design*
    3. *Synthesation of natural and synthetic hydrogels with desired physical properties.*
4. *The economic and environmental conditions and impacts associated with future mass production of natural hydrogels for solar refrigeration*

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Contribution of the project to AU – EU R&D cooperation

- The project will improve the international EU-Africa cooperation by creating liaisons with green energy sector-related stakeholders from renewable energy and clean cooking and refrigeration solution providers, SMEs, technology suppliers, energy professionals and policymakers. The network will extend to potential investors and finance organisations.
- The close collaboration, know-how, and knowledge transfer between EU-African partners envisaged in project work packages will strengthen the visibility of EU Cooperation, Partnership and Diplomacy actions in Africa.
- It is hoped that the collaboration between universities and technology centres will be strengthened and that it will last beyond this project and become a regular feature.

Interest of Consortium members in participating in LEAP-RE clustering activities

Not yet discussed in depth, but…

1.-Mapping joint research and innovation actions for future RES development – Consolidation of detailed map of R&I initiatives in Europe and Africa per technology, application etc. type with the aim to support the RE industry to prioritize and contextualize target areas of RES deployment

2. **End-of-life and second-life management and environmental impact of RE components** - Map the component value chain, identification of key stakeholders & successful business models promote replicability scenarios of operational models and standard operating procedures in concerned regions

3. **Smart stand-alone systems (SAS)** - Promote the development of RE-SAS demonstrator(s) considering the diversity of potential local RE sources and the local effective environment

4. **Smart grid (different scale) for off grid application** - Development of new tools for optimizing capacity in planning and dispatching strategies based on people's needs with the aim to reduce the energy dependence on fossil fuel and increasing the share of RES use including electricity storage solutions such as batteries, hydrogen…

5. **Processes and appliances for productive uses (PRODUSE)** – Improvement and Promotion of wider use of PRODUSE appliances for Cold chain and thermal tools and equipment's (healthcare and agriculture - livestock, fisheries and farming)

6. **Innovative solutions for priority domestic uses (clean cooking and cold chain)** - Improving, managing and maintaining solar photovoltaic systems, cookstoves and cold chain components for clean cooking and food storage. Supporting interactions with policymaking to foster fast market uptake considering the macro socio-economic and gender impacts

THANK YOU

CONTACT US FOR MORE INFORMATION

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Pilot Demonstration site – Nigeria, Ako-Nike Community

The *rationale for selecting Nigeria, Ako-Nike Community* as a demonstration site for the SOLAR INDUCE project is

- **Nigeria's largest economy in Sub-Saharan** Africa and **one of the most densely populated countries in the world**.
- The country is endowed with large oil, gas, hydro, wind and solar resources, but power is insufficient and distributed in 5 hours by load sharing even in urban areas.
- The region's **energy supply is highly centralised** and relies excessively on the state energy companies.
- Lack of infrastructure has led to **poor electrification in rural areas**, which are sparsely located and populated by low-income communities that pay a subsidised tariff that increases the burden of government spending.
    - To facilitate the provision of affordable power supply for residential, commercial, industrial and social activities in the rural and peri-urban areas of the country, the Nigerian Rural Electrification Agency (REA) concentrates on providing off-grid solutions to rural dwellers such as mini-grids and solar home systems with a complete access rate over the next ten years.
    - The goal is to encourage and promote private sector participation in rural development using the nation's abundant renewable energy sources (solar, thermal, hydro, wind, biomass) while ensuring that Government Agencies, Cooperatives and Communities, actively participate in the implementation of energy efficiency measures to enhance electricity service delivery by 2030.
    - Therefore, the **legislation is more open to implement and demonstrate more ambitious and innovative technologies**.
- In this pilot, we will demonstrate a solar induction cooking system, which will be implemented in the Ako-Nike community. The site includes **1500 households** with close vicinity to schools, churches, and farms. This will be an **ideal site for testing** and demonstrating the technology and also for the mass training of the population.
- This pilot sets out **a technically ambitious goal**: to develop a novel high performance, cost-efficient solar-powered induction cooking system for application in rural communities and in small business residential buildings in remote areas of Sub-Saharan Africa.
- The proposed system will include several components, each of which will have originality in their engineering design solution and embodiment to achieve the above ambitious goal. Detailed studies of environmental issues have been performed to ensure that the proposed technology is sustainable.

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Pilot Demonstration site – Nigeria, Ako-Nike Community

1. Piloting

- *The project will achieve its goals by smaller-scale pilots with a greater impact in terms of geographical coverage and replication potential.*
- *To contribute to the energy transition by increasing the viability of solar-powered cooking and refrigeration systems, partners focused on 3 African countries (South Africa, Egypt and Nigeria) applying innovative technologies and business solutions.*
- *After installation and commissioning, the performance of all components and the whole system will be monitored and recorded using a modern data acquisition system (DAQ) to detect a possible mismatch between characteristics of separate components during their interaction. These field tests will be carried out for daytime and nighttime operation at summer and winter conditions.*

2. First market replication

- SOLAR INDUCE is expected to have 15 years lifetime with a 10% improvement of efficiency at energy transfer for induction cooking powered by off-grid solar PV.
- The business potential will be assessed during the project demonstration results regarding costs and the interest of project partners such as COPRECI and SPG to distribute these technologies.
- Technologies will be assembled locally with a number of components also sourced locally. Local manufacturers will be identified during the project to maximise the local production, and most of the refrigeration and metal components of the systems are recyclable, ensuring the possibility to tailor the local value chain.
- Due to reductions in capital costs and efficiency increases, the cost of the refrigeration system is expected to decrease by 25% in 4 years and, by 50% in 10 years.
- The induction cooktop will be optimised to minimise costs at the end of the project.
- The project results will directly benefit industry (COPRECI) and SME (SPG) in the project in terms of demonstrated technologies and products in an emerging market area and will therefore provide the opportunity to generate new sales.
- For stakeholders, the project is a way to secure greater market share and turnover by increasing competitiveness. This will indirectly benefit the agricultural and farming sectors and public sectors through demand for local manufacturing and installing greener and highly energy-efficient cooking and refrigeration technologies.

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Estrategia de explotación y difusión.

- Stakeholders' involvement can take various forms such as local groups, task force for dialogue advocacy, awareness-raising or focus group discussions. Community engagement, public outreach, and multi-stakeholder dialogue, including the private sector, will be necessary steps to achieve the project's objectives, enforce and enhance the project's pilot actions, and achieve the shift in urban-rural policies and practices towards the implementation of SDG7.
- Producing a valuable and significant impact as a result of innovative solutions will be the focus of our exploitation and dissemination strategy. On the completion of the project, it is expected to advance the knowledge and prove the technological feasibility of producing novel clean and cost-effective cooking and food storage technologies, including their environmental, societal and economic benefits. The outcomes of the project will contribute to establishing a solid European innovation base and building a sustainable, renewable energy system contributing to the decarbonisation of EU and African economies. The proposed solutions are expected to contribute to strengthening the EU leadership on domestic renewable energy solutions.