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Final monitoring, evaluation and impact assessment report of co-funded projects

Authors : Mokthar SELLAMI (MESRS), François MOISAN (ANR)

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Date	By
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LEAP-RE

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

Research & Innovation Action

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D8.3 LEAP-RE Pillar 1 projects evaluation

Authors:

Francois Moisan(ANR), Wassim SEBAI (ANR), Mokhtar Sellami (MESRS)

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Disclaimer

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Executive summary

This report presents an evaluation of the 23 projects funded under the two LEAP-RE Pillar1 co-funded calls (call 2021 and call 2022). They address the different 6 Multi Annual Roadmaps identified in the call text:

- Mapping renewable energy joint research and innovation;
- End of life of renewable energy components;
- Smart stand-alone systems;
- Smart grids;
- Productive uses of energy;
- Domestic uses of energy.

These evaluations have been completed by independent experts on the basis of final reports provided by coordinators of projects and the final presentation of results during two stakholders forums organized in Brussels at the European Commission CDMA headquarter in October 2025 and May 2026.

Since projects are often addressing several MARs (Multi Annual Roadmaps), the presentation of the projects evaluation follows a slightly different thematic structure than the MARs. :

- Biomass transformation for energy uses;
- Clean cooking;
- End of life and recycling;
- Digital tools for smart grids and stand alone systems;
- Productive uses in agriculture and other applications;
- New renewable energy sources and green hydrogen.

Each funded project was assessed through 3 criteria from evaluators:

- Scientific and technical objectives and results
- Project outcomes and impacts

Planning, coordination and collaborationIn addition, an overall comment of the project was required to the experts.

The report aims to present the scientific evaluation of co-funded projects. It complements the deliverable D1.18 on Monitoring Evaluation and Learning focused on the evaluation of cofounding activities.

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1. BIOMASS TRANSFORMATION FOR ENERGY USES TOPIC

This topic covers the transformation of biomass in sustainable ways to produce energy (gas or liquid biofuels and biochar) to be used for cooking, power or heat production (Biotherep, Pyrobiofuel, Vill2bio) and the transformation of agricultural products for food using solar energy (Sungari).

The objectives of the projects focus on renewable fuels production for cooking rather than the development of clean cooking equipment which are presented in topic N°2 (clean cooking).

The projects rely on the valorisation of agricultural wastes, slaughterhouse waste water in a circular economy scheme alternative to firewood exploitation.

The technologies addressed by the projects rely on biochemical and thermochemical transformation of biomass.

Several projects experimented field or laboratory demonstrators with market perspectives.

The 4 projects identified are:

- BIOTHEREP (Call 2023)
- PyroBiofuel (call 2022)
- Sungari (call 2022)
- Vill2Bio (call 2023)

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BIOTHEREP

BIOTHEREP: **Hybrid biochemical and thermochemical conversion of slaughterhouse biowaste for Renewable Energy production**

Coordinator: Mohammed VI Polytechnic University (Morocco).

Partners:

- Ibn Tofail University (Morocco), UKZN – University of KwaZulu-Natal, South Africa
- Mangosuthu University of Technology (South Africa)
- Fountain Green Energy (South Africa),
- Università degli Studi di Perugia (Italy)
- HTW Berlin – University of Applied Sciences (Germany)
- Institut de combustion, aérothermique, réactivité et environnement (France)
- Centre de développement des Energies Renouvelables (Algeria)

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project methodology and design are scientifically sound as they involve a multi- and inter-disciplinary approach from academic rigour to industry and civic society engagement.

The work was spread across partners in Africa and Europe with each partner assigned a specific work package (WP) or activity in the WP.

The Life Cycle Assessment (LCA) approach brings a holistic view to the research work through cost-benefit analyses to inform decision-making and optimize sustainability.

New insights were presented in the form of higher yields of hydrogen and syngas production with new pathways introduced.

The project is reported as significantly having progressed well.

There are 3 main results of the project that have been highlighted:

- **Valorization** through demonstration of the strong potential of slaughterhouse waste digestates for thermochemical valorization through pyrolysis and gasification;
- **Environmental Benefits** with demonstrated net environmental savings, particularly in fossil resource depletion and water use indicators;
- **Knowledge Generation** through integrated sustainability assessment methodologies developed and shared

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Capacity building has been limited to communication and dissemination activities in scientific workshops. However, the integration of project results into higher education, through courses, student projects, and master's theses, is expected to ensure long-term knowledge transfer and contribute to capacity building within the next generation of scientists and engineers.

2) PROJECT OUTCOMES & IMPACT

Scientific impact has been noted in various presentations at conference and contribution to the bachelor's degree in chemistry at University of Perugia through a course on Chemical Processes for Biomass Valorization illustrating the project's contribution to knowledge transfer and strengthening the link between funded research and higher education.

Up to 12 presentations at conferences are listed whilst a publication for Springer book series is still pending. It is stated there is an article on slaughterhouse waste valorization strategies, which was published in the international journal "Resources, Conservation & Recycling".

The policy paper on the project, which is aimed at presenting a harmonized framework of procedures and good practices for the sustainable valorization of slaughterhouse waste, based on the experiences and results of the partners is expected to have some significant social and cultural impact.

The workshops, seminars and training sessions which were organised by the project team can be considered as having contributed significantly to the scientific and general community.

Although in the proposal, the project claims that gender balance will strongly consider since the impact of the project will benefit wide range of communities in African regions including the most susceptible categories (e.g. children, women, and indigents). The proposal further states that a gender-sensitive language will be used in research and communication, and the gender balance will be sought in all participatory activities. However, the final report provides no evidence or information on gender related outcomes, including the categories identified in the proposal

3) PLANNING, COORDINATION, COLLABORATION

The project was structured into 8 WPs with each partner assigned to a specific task. The overall coordination was by Mohammed VI Polytechnic University of Morocco. African partners managed feedstock sampling, characterization, and biochemical conversion at the laboratory scale, while European partners focused on converting di-gestate into additional energy and biochar, refining existing setups and developing new prototypes for improved energy production.

In terms of timeline, the project had been planned for 24 months but was however extended by another 9 months due to unforeseen delays. The project faced challenges such as contract

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agreement delays as well as shipping samples to Europe due to regulatory requirements. This contributed to overall project delays.

Coordination and communication were critical in managing timelines and milestones. It is reported that there was a robust system for scheduling and monitoring meetings, including the kick-off, in-person consortium meetings and quarterly online progress meetings.

The project consortium was able to quickly adapt to delays and changes. For instance, the withdrawal of Egypt affecting Cairo University and the subsequent addition of Stellenbosch University, ensured continuity and integration of new expertise thus maintaining scientific consistency.

Worth noting is that the project conducted a structured SWOT analysis to identify and mitigate technical, operational, economic, and regulatory risks across the value chain.

It is evident that the collaboration yielded significant results for the project.

4) OVERALL COMMENTS

One would say that despite the challenges and failure to address gender issues, the BIOTHEREP project demonstrated strong and adaptive planning and organization throughout its lifecycle. The consortium was able to respond to challenges, maintain effective communication, and achieve its objectives. The use of interdisciplinary approaches, regular monitoring, and stakeholder engagement further contributed to the project's success.

The BIOTHEREP project advances AU-EU long-term cooperation by knowledge exchange between African and European institutions, building shared research capacity, harmonizing sustainability assessment methodologies and strengthening a lasting Africa-Europe innovation partnership capable of scaling circular bioeconomy technologies across both regions.

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PyroBioFuel

PyroBioFuel: Sustainable biomass conversion into bioenergy through pyrolysis.

Coordination: Cairo University (Egypt)
Partners:

- Ibn Tofail University - Research Institute for Solar Energy and New Energies (IRESEN), (Morocco)
- Uni. Witwatersrand (South Africa)
- Brandenburg University of Technology (BTU-C-S), (Germany), CNRS PIMM (France)

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project combines experimental pyrolysis (bench-scale, 200–700°C), catalytic upgrading, mathematical modelling, and Life Cycle Assessment/techno-economic assessment (LCA/TEA) across five interlinked work packages in a coherent, multi-method design appropriate for a technology development project of this scope. This is evidence of a strong and well-structured design.

The methods seem to appropriate and rigorously applied evidenced by standardized characterization techniques, controlled catalyst testing (fixed-bed reactor at defined T/P/flow), and validated Aspen Plus process simulation. The use of multiple kinetic models and cross-validation against literature adds credibility.

The research results are quantified with clear figures (e.g., 70% CO conversion, ~50% jet-fuel selectivity, bio-oil yield rising from 21.8% to 28.2% with temperature) and cross-checked via simulation vs. experiment. However, validity is somewhat limited by one acknowledged deviation where model gas compositions were used for catalytic testing rather than real pyrolysis-derived feeds, due to upstream data delays.

Cited key novel contributions to new knowledge includes the bifunctional Co/zeolite FTS-HCR catalyst (single-system synthesis + hydrocracking), FeMnK catalysts for CO2-rich syngas utilization, and comparative 3D-printed microchannel reactor geometries (circular achieving best CO2 conversion, ~37%). These represent genuine advances in catalytic design and reactor intensification for biomass-to-fuel pathways.

The report states all major milestones were completed. No major scope deviations were reported, aside from the noted feedstock-testing substitution in WP2.

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The main results at final term include:

- Optimized bench-scale pyrolysis producing bio-oil, biochar, and syngas from multiple agricultural residues;
- Catalytic upgrading achieving ~70% CO conversion and ~50% jet-fuel selectivity via Co/zeolite FTS-HCR catalysts;
- Validated mathematical model – the Aspen Plus mass/energy balance model (e.g., 1 kg/h biomass → 0.327 kg/h biochar, 0.197 kg/h bio-oil, 0.413 kg/h syngas);
- LCA/TEA showing CKD as more environmentally favourable than ZnO catalysts, despite ZnO's higher profitability;
- Three tested microchannel reactor geometries for process intensification.

Capacity building is clearly demonstrated through trained postgraduate students, postdocs, and technical staff across five institutions; established a functioning pyrolysis experimental platform (Egypt, South Africa); and **24+ peer-reviewed publications** plus multiple conference outputs, strengthening long-term AU–EU research capacity in catalysis, reactor engineering, and sustainable fuel production.

2) PROJECT OUTCOMES & IMPACT

The scientific impact is solid, spanning catalysis, reactor engineering, and sustainability assessment. Economically, the project identifies concrete market pathways including bio-oil for fuel/chemical feedstock, biochar for soil improvement/wastewater treatment/construction materials, and syngas for heat/power, with potential to support rural job creation and new circular-bioeconomy value chains. Socially, it offers an alternative to open burning and uncontrolled agricultural waste disposal, addressing pollution and resource loss in North Africa.

The consortium reports 26 listed publications (24 peer-reviewed and 2 non peer-reviewed) which is a mix of peer-reviewed journal articles and conference proceedings. Participation in conference participations, workshops, and training activities is also listed with an outreach spreading to scientific-community members, general public, policymakers, and industry contacts.

Standout contributions in terms of innovation in the results include:

- bifunctional Co/zeolite catalyst integrating Fischer-Tropsch synthesis and hydrocracking in one system (achieving ~70% CO conversion, ~50% jet-fuel selectivity with no heavy wax formation);
- FeMnK catalyst for CO2-rich syngas utilization, and;
- comparative testing of three 3D-printed microchannel reactor geometries.

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The added value is amplified by combining African biomass/feedstock realities with advanced European catalytic and reactor engineering, producing results relevant to both fundamental catalysis science and localized African biomass economies.

However, the Final Report does not address the gender dimension at all.

3) PLANNING, COORDINATION, COLLABORATION

The project maintained a clear five-work-package structure (pyrolysis, catalytic upgrading, modelling/simulation, TEA/LCA, validation demonstrator) across a 36-month timeline plus extension (Oct 2022–March 2026), and the report confirms it progressed "as planned and in line with proposal objectives" with no major scope deviations reported. The consortium was able to redistribute tasks in WP2 when equipment procurement was delayed without derailing the overall plan.

Coordination among the five-partner consortium (Cairo University as coordinator, Ibn Tofail/IRESEN, Wits University, BTU Cottbus-Senftenberg, CNRS PIMM) was clear and functional, with work packages cleanly divided by institutional expertise (e.g., Cairo/Wits for bench-scale pyrolysis, BTU for catalytic upgrading and microchannel reactors, CNRS for kinetic/TGA studies on palm biomass). Regular partner meetings across Cairo, Paris, Cottbus, Johannesburg and online coordination calls supported this coordination. Change leadership due to the retirement of one WP leader was handled smoothly without disrupting deliverables.

The report states 100% milestone completion but they also report on equipment procurement delays influencing WP2's catalytic testing schedule, forcing the use of representative model gas compositions instead of real pyrolysis-derived feeds. On top of that, the overall 36-month-plus-extension timeline also suggests some schedule pressure, though apparently less severe.

The collaboration's added value appears genuinely strong judging from the combination of North African biomass/contextual expertise with European and South African technical depth to produce integrated, publishable results and active participation in 19 conferences.

4) OVERALL COMMENTS

- Strong, integrated technical delivery combining bench-scale pyrolysis, catalytic upgrading process simulation, and LCA/TEA into a coherent pipeline
- Some innovation in single-system FTS-hydrocracking catalyst, FeMnK catalysts for CO2 utilization, and 3D-printed microchannel reactor geometries relevant to sustainable aviation fuel and process intensification.
- Excellent dissemination output through publications, conference participations, workshops, etc.

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- Hands-on training of postgraduate students and technical staff across Africa and Europe backed by a fully operational pyrolysis experimental platform.
- Capabilities between the two continents, Africa and Europe are combined in the project exemplifying the kind of co-developed innovation AU-EU cooperation aims for. It also builds lasting research capacity through hands-on training of postgraduate students and technical staff across five institutions, a fully operational pyrolysis platform, and 26+ joint publications, indicating durable institutional and human-capacity gains beyond the project's funding period.

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SUNGARI

SunGari : A modern solar cooking solution for African staples

Coordination: Natural Resources Institute, University of Greenwich (UK)
Partners:

- University of Pretoria (UP), South Africa
- University of Limpopo (ULi), South Africa
- Department of Biosystems Engineering, University of Kassel, Germany
- Simply Solar Technology Consulting GbR (SST), Germany
- University of Lome (ULo), Togo

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The SunGari project demonstrates solid scientific soundness in its methodology, combining Design of Experiments (DoE)-based process optimization with an integrated Life Cycle Sustainability Assessment (LCSA) framework that merges Material and Energy Flow Analysis (MEFA), ESG indicators, and double/dynamic materiality. This is an appropriately multidisciplinary approach for a technology that spans engineering, environmental science, and socio-economic dimensions.

The research methods (lab-scale DoE testing, proximate analysis, field prototyping across Germany, South Africa, Zambia, and Togo, and participatory stakeholder co-design) appear rigorously and consistently applied across work packages. However, the report itself provides limited detail on statistical validation, sample sizes, or replication, making it hard to independently verify the robustness of claims like the 80% energy reduction or 65% efficiency figures.

The stated results are plausible and consistent with the underlying engineering logic (PV/electric heating replacing inefficient woodfuel roasting) and are corroborated by peer-reviewed publications (Thermal Science and Engineering Progress, Sustainable Production and Consumption, Energies-MDPI), lending credibility and external validation to the findings.

The project clearly contributes new knowledge, particularly through its novel integrated LCSA methodology (combining MEFA with dynamic/double materiality) and its machine-learning-based modeling of roasting parameters, both of which are transferable to other staple-food processing contexts beyond Gari.

Progress against the original proposal appears strong and largely on-track, with all six work packages completed, three prototype systems (PV-electric, PV-steam, Scheffler solar concentrator) designed and validated, and demonstration/training activities delivered in Togo.

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At final term, headline results include:

- a system efficiency increases from 28% to 40–65%;
- an 80% cut in energy consumption (7.07 to 1.45 kWh/kg);
- improved product quality (~30% per indicator);
- improved net profit margins (34% to 52%).

Capacity building was a genuine strength, with roughly 100 stakeholders trained (mostly University of Lomé students) and strengthened Africa-Europe/South-South collaboration. Dissemination beyond academic circles was, however, modest highlighting that the project excelled scientifically and technically but under-invested in broader outreach and market-facing valorization relative to its stated commercialization ambitions.

2) *PROJECT OUTCOMES & IMPACT*

The project shows solid scientific impact though 4 peer-reviewed publications, a conference contribution and meaningful potential economic impact. The economic impact results in 65% reduction in operational energy costs, improved NPM from 34% to 52% and SME scalability. This is alongside social impact through improved working conditions, reduced smoke/heat exposure for women processors as well as cultural relevance by preserving and modernizing a traditional staple food process.

Dissemination has occurred but remains modest: no significant press, social media, exhibitions, or public communication campaigns were undertaken, meaning reach was concentrated in the scientific community versus limited engagement with industry, policymakers, or the general public.

The project integrated LCSA framework (MEFA + ESG + double/dynamic materiality) and comparative validation of three distinct solar roasting technologies (PV-electric, PV-steam, Scheffler concentrator) which represent a transferable methodological and technical contribution beyond the immediate Gari use case.

On gender equality, the project contributed meaningfully by directly targeting a value chain where 80% of workers are women, improving their working conditions and reducing health risks (smoke/heat exposure), and reporting that a third of processing operations being women-led. The scientific report doesn't detail any structural interventions specifically aimed at increasing women's leadership, ownership, or decision-making power beyond these baseline observations, so the gender contribution appears more as a beneficial byproduct of the technology than a deliberately engineered equity outcome.

3) *PLANNING, COORDINATION, COLLABORATION*

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

The consortium completed all six work packages and delivered core technical, validation, and dissemination outputs despite minor cross-country logistical delays, indicating that project planning and organization were effective overall.

Coordination among partners in UK, Germany, South Africa, Togo appears to have been well-managed, with clear Work Package ownership and regular communication supporting technical alignment.

The international collaboration added clear value by combining European engineering/sustainability expertise with African contextual knowledge and field access thus strengthening Africa-Europe and South-South research ties and producing a genuinely transdisciplinary, field-validated outcome. The added value is somewhat tempered by the very limited external dissemination and stakeholder reach beyond academia, suggesting the collaboration was scientifically satisfying but under-leveraged for broader impact.

4) OVERALL COMMENTS

- Strong technical achievement: three validated solar roasting prototypes with substantial, credible performance gains (80% energy reduction, higher efficiency, better product quality)
- Genuinely interdisciplinary methodology, anchored by an innovative integrated LCSA framework with real transferability beyond this project
- Solid peer-reviewed scientific output validating the work
- Meaningful capacity building and Africa-Europe/South-South collaboration
- Direct, tangible benefits to a vulnerable, women-led workforce
- A technically strong pilot with excellent scientific foundations, but one that would benefit significantly from a stronger bridge to market uptake and broader dissemination to fully realize its stated ambitions.

SunGari contributes to long-term AU-EU cooperation by co-developing a new solar-roasting solution merging European renewable energy/engineering expertise with African contextual and field knowledge, building lasting research capacity through hands-on training (~100 stakeholders, mostly University of Lomé students) and multi- country technical collaboration (UK, Germany, South Africa, Togo), and laying groundwork for continued partnership via planned incubation support at the University of Lomé and University of Pretoria. However, its long-term strategic contribution remains partial, since the lack of broad dissemination and an as-yet-unrealized commercialization/start-up pathway limit how far this capacity-building translates into sustained, scaled AU-EU innovation infrastructure.

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Vil2Bio

Vil2Bio: Combining village-scale biogas production with pyrolysis in biomass stoves for off-grid sustainable clean cooking and cold production (Vil2Bio)

Coordinator : Laboratoire De Genie Des Procedes – Environnement – Agroalimentaire GEPEA (France).

Partners :

- Institut de combustion, aérothermique, réactivité et environnement ICARE (France)
- Altran Technologies (France)
- Centre de développement des énergies renouvelables (Algeria)
- Hamburg University of Technology TUHH(Germany)
- International Biogas and Bioenergy Competence Center (Germany)
- Kenya Industrial Research and Development Institute (Kenya)
- University of Nairobi (Kenya)
- Université Hassan Ier (Morocco)
- Sultan Moulay Slimane University (Morocco).

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project is scientifically solid and brings together several well-established technologies like biogas, pyrolysis, microalgae, and water treatment in a way that fits well with local African conditions. The methods used are robust and appropriate, and the results are generally reliable, showing good performance across different systems, even though some planned activities could not be fully completed due to the withdrawal of one partner. Overall, the project delivered several meaningful technical outcomes, including working biogas systems, tested cookstove designs, effective CO_2 removal through water scrubbing, and early success in using microalgae with digestate. It also created new knowledge by linking biochar use with circular bioenergy systems. In addition, it made a strong contribution to capacity building through hands-on training, cross-country exchanges, and involving local farmers directly in the project activities.

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

2) *PROJECT OUTCOMES & IMPACT*

The scientific approach of the project is very comprehensive and focuses on practical clean cooking and circular energy solutions that could make a real difference in rural African communities by reducing deforestation, indoor air pollution, and reliance on traditional fuels. Dissemination has been active through conferences, public events, webinars, and outreach activities, with one journal paper already submitted. A key strength is the innovative integration of different technologies- biogas, biochar, water treatment, and microalgae- into one circular system, including creative use of waste streams for multiple purposes. The project also shows a clear commitment to gender equity, both in its leadership structure and in its focus on technologies that can reduce the workload of women and girls in daily household energy tasks.

3) *PLANNING, COORDINATION, COLLABORATION*

The project was generally well organized, with a clear structure and good coordination across a large international consortium. However, the withdrawal of one partner created some gaps and required adjustments in responsibilities and planning. Coordination was maintained through regular online meetings, shared platforms, and consortium reporting, which helped keep the work aligned despite the geographic spread of partners. Most milestones were achieved, although some delays occurred, particularly in the Moroccan pilot and the IoT system, which was not fully completed. Overall, the EU-Africa collaboration was a clear strength, bringing together complementary expertise from European and African partners and enabling results that would not have been possible within a single region.

4) *OVERALL COMMENTS*

The project has strong scientific relevance and focuses on practical clean cooking and circular energy solutions that could make a real difference in rural African communities by reducing deforestation, indoor air pollution, and reliance on traditional fuels. Dissemination has been active through conferences, public events, webinars, and outreach activities, with one journal paper already submitted. A key strength is the innovative integration of different technologies- biogas, biochar, water treatment, and microalgae- into one circular system, including creative use of waste streams for multiple purposes. The project also shows a clear

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commitment to gender equity, both in its leadership structure and in its focus on technologies that can reduce the workload of women and girls in daily household energy tasks.

Vil2Bio is an ambitious and socially relevant project that successfully demonstrated a multi-technology circular energy system at pilot scale in Kenya and Morocco, supported by strong North-South and interdisciplinary collaboration. Its main limitation is that the withdrawal of one partner constrained the planned upscaling to village level and limited full implementation of the Moroccan pilot as originally envisioned.

Vil2Bio makes a strong contribution to AU-EU cooperation by establishing a lasting research network across France, Germany, Algeria, Morocco, and Kenya. The collaboration has already led to follow-up and submitted projects, showing that the partnerships created during the project are continuing to generate new research and innovation opportunities.

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2. CLEAN COOKING TOPIC

This topic covers the research and innovation on clean cooking devices alternative to traditional biomass stoves. It aims to reduce deforstation and air pollution caused by traditional stoves.

The projects experiment new cooking devices using solar energy (thermal or electricity) and innovative stoves reducing energy consumption and air pollutants. Some technologies may also produce cooling for agriculture products conservation. Electric cooking devices are experimented for African context.

The projects explore market readiness with high promising potential deployment.

The projects illustrate the large scope of clean cooking solutions in Africa depending on different contexts (rural, urban, climate conditions, revenue…).

- SoCoNexGen (call 2022)
- Solar Induce (call 2022)
- SHE (call 2023)

SoCoNexGen

SoCoNexGen: Solar Indoor Cooking Systems of the Next Generation

Project coordinator : Aachen University of Applied Sciences, Germany

Partners :

- Ingenieurbüro für Energie- und Umwelttechnik (IBEU) Germany
- low-tec gGmbH (lowtec) Germany
- Universidade de Évora (UdE) Portugal
- Université Mohammed Premier Oujda (UMP) Morocco
- Université de Tunis El Manar (UTM) Tunisia
- Centre de développement des énergies renouvelables (CDER) Algeria

Evaluation :

1) SCIENTIFIC AND TECHNICAL OBJECTIVES

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

Overall, the project was scientifically sound and well designed in principle, with an appropriate comparative methodology, but its implementation was uneven and did not fully follow the original plan. Research methods were generally appropriate, although testing, modelling, and validation were inconsistently applied across partners, resulting in more reliable and exploitable results for the PV-battery cooker (Cooker 3) than for the oil-circuit cookers, one of which remained untested. The project nevertheless generated new knowledge, including the identification of key technical limitations and design solutions, supported by a patent and 20 scientific publications. However, progress was delayed, requiring an eight-month extension, and several milestones and expected outcomes were only partially achieved. At final term, Cooker 3 was successfully developed, tested, and positively evaluated by users, while the oil-circuit cookers generally failed to reach their target temperatures. The project also contributed significantly to capacity building through the involvement of PhD and master's students, technical training, workshops, knowledge transfer, and dissemination activities across the partner countries.

2) PROJECT OUTCOMES & IMPACT

The project generated a measurable scientific impact, with 20 publications and one patent, although the main advances were concentrated on the PV-battery cooker. Economic and social impacts remain largely prospective, with follow-up development and potential local deployment in Morocco, while environmental benefits such as reduced firewood use and smoke exposure were not systematically measured across the project. Dissemination was substantial, including peer-reviewed publications, conferences, workshops, exhibitions, media activities, and training. Innovation was strongest in the autonomous, patent-protected PV-battery cooker, while the oil-circuit cookers mainly provided useful design lessons but remained insufficiently validated. The contribution to gender-equal development was described primarily as an expected societal benefit of reducing women's and girls' burden of fuel collection and exposure to indoor smoke; however, no project-specific gender-disaggregated data or measured outcomes were provided,. Overall, the project demonstrated clear scientific and technological value, but broader economic, social, environmental, and gender impacts remain insufficiently evidenced.

3) PLANNING, COORDINATION, COLLABORATION

Project management and coordination were only partially effective. Although responsibilities were clearly allocated, communication among partners was inconsistent, with lengthy and poorly attended meetings, language barriers, limited use of shared tools, and uneven reporting. Timelines were not fully respected, requiring an eight-month extension, and several

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

milestones and dissemination activities remained incomplete. International collaboration nevertheless generated tangible value through knowledge transfer, joint workshops, and complementary expertise across countries, but its full potential was constrained by delays, coordination issues, customs-related problems, and incomplete integration of partners' work. Overall, the project achieved some meaningful collaborative outcomes, but management and coordination weaknesses significantly limited the effectiveness of the partnership.

4) OVERALL COMMENTS

This cooker line is a genuine strength of the project. It is patent-protected (OMPIC MA62943, positive examination report, published), was tested both in the laboratory and with 4 families in a rural forested area, generated predominantly positive user feedback, and is set to continue development until 2027 through a follow-up project with a Belgian partner (WBI/Mons). The project's publication record (20 outputs, largely concentrated on this cooker line) and its transparent, open-access documentation of its own technical difficulties are also positive features. The three oil-circuit-based cookers (1a, 1b, 2), by contrast, underperformed their design targets: cookers 1a and 2 reached lower temperatures than planned (about 140-190degC and about 160degC respectively, against targets of 250degC and 200-230degC), cooker 1b was never tested, and the project's own conclusion states that these cookers would have needed more detailed testing to enable a comparison between one another. Overall, SoCoNexGen is a project of genuinely mixed results, honestly self-reported strong, well-validated and commercially promising progress on its PV/battery cooker line, alongside substantially incomplete results and acknowledged management difficulties on its three oil-circuit cooker lines.

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SOLAR INDUCE

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

Project coordinator : COPRECI S Coop, Spain
Partners :

- University of Northumbria (UNN) UK
- Enugu State University of Science and Technology (ESUT) Nigeria
- S&P Global Resources Nigeria Limited (SPG) Nigeria
- Tshwane University of Technology (TUT) South Africa
- Walter Sisulu University (WSU), South Africa
- The British University in Egypt (BUE) Egypt

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project demonstrates strong scientific quality and clear technological potential, with a well-conceived comparative design and appropriate, generally rigorous methodologies. The induction-cooker and hydrogel components produced credible and practically relevant results, including a TRL 5 prototype, significant cost-reduction potential, and substantial improvements in passive cooling performance. However, the project's overall scientific achievement is weakened by the incomplete absorption-refrigeration work, which remained at the simulation stage and could not be experimentally validated, as well as by the absence of the planned field pilots in Nigeria and Egypt. The project generated valuable new knowledge and six peer-reviewed publications, particularly in the hydrogel research line, but dissemination and scientific outputs were less balanced across the technical components. Significant implementation and funding delays also affected the achievement of milestones and required an extension. Overall, the project delivered meaningful and scientifically credible advances, with strong results in induction cooking and passive cooling, but only partial achievement of its full objectives and expected validation pathway. Capacity building was initiated through training and knowledge transfer, although evidence of its scale and longer-term impact remains limited.

2) *PROJECT OUTCOMES & IMPACT*

The project generated clear scientific and technological outputs, but its broader impact remains largely potential. Achieved impact includes six peer-reviewed open-access

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publications, validated modelling approaches, a TRL 5 induction-cooker prototype, and demonstrated natural-hydrogel cooling performance, with the latter providing 10–13 hours of additional passive cooling compared with frozen water. The induction cooker also demonstrated a potential cost-reduction pathway of up to 50%, although this should be considered a projected economic benefit rather than realised market impact. Potential impact includes future industrial uptake, wider deployment of low-cost induction cooking and hydrogel refrigeration, environmental and social benefits from reduced reliance on conventional fuels, and gender-related benefits from reducing cooking and fuel-collection burdens. However, these wider impacts were not demonstrated at beneficiary level because the planned Nigeria and Egypt field pilots were not conducted. Overall, the project delivered credible scientific and technological results, while its economic, social, environmental, and gender impacts remain primarily prospective and require further field validation and deployment.

3) PLANNING, COORDINATION, COLLABORATION

The management structure, allocation of responsibilities, and regular coordination mechanisms were appropriate, and there is evidence of good oversight and effective collaboration among several partners. However, management performance was significantly affected by external funding and start-up delays, which resulted in highly asymmetric partner involvement and disrupted the project schedule. The late start of BUE and the resulting delay in WP4, together with incomplete tasks and the unimplemented field pilots in Nigeria and Egypt, indicate that project monitoring and corrective action were not sufficient to keep the work fully on track. The six-month extension partially mitigated these difficulties but did not allow all planned activities to be completed. Overall, management provided a sound framework and maintained consortium coordination, but its effectiveness was moderate rather than strong, as important delays and implementation gaps remained unresolved.

4) OVERALL COMMENTS

The project pursued two genuinely complementary off-grid solutions, solar-PV-powered induction cooking and solar-heat powered refrigeration with passive-cooling hydrogel sachets and achieved clearly documented, tested results on two of its three technical lines. A functional induction-cooker prototype (TRL 5, with validated worktop materials, a validated electromagnetic model, and up to 50% potential cost reduction), and thoroughly characterised, high performing natural-hydrogel passive cooling sachets synthesised from local African biomass (dika nut, cacao, taro tuber, sugar cane bagasse), which sustained 10-13 hours of additional passive cooling compared with frozen water and generated 6 peer-reviewed, open-access publications. The third technical line, the solar absorption refrigeration cycle led by the British University in Egypt, is a genuine weakness at final term. Engineering

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design and dynamic simulation were completed, and an important negative finding was documented, but the physical unit was never manufactured, owing to local fabrication constraints in Egypt, and a formal extension request remained unanswered at the time of the final report. The project also explicitly did not progress as planned overall: funding delays for several partners, which required a six-month extension; neither of the two originally planned field pilots (a cooking pilot in Nigeria, a refrigeration pilot in Egypt) was executed within the project timeline, meaning the project's social and economic impact claims (job creation, food-loss reduction, reduced fuelwood collection by women and children) remain expectation based rather than field verified for this project's own beneficiaries. The project generated real follow-on momentum; the LEAP-RE Stakeholder Forum networking (Pretoria 2022, Kigali 2023) led to Kenya Community of Practice membership, two new joint R&D proposals, and industrial interest from a Spanish component manufacturer, culminating in a clearly articulated, re-focused follow-on project aimed at deploying a pilot in Kenya. Overall, SOLAR INDUCE is a project of mixed self-reported results, strong, tested and published progress on induction cooking and hydrogel-based passive refrigeration, alongside an incomplete absorption-refrigeration subsystem and two unexecuted field pilots, both attributed mainly to external, funder side delays rather than to the project's own scientific or technical shortcomings.

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SHE

SHE: **Smart Home Energy:** Development of an integrated and mobile solution for low-cost cooking and power generation

Coordinator: Graz University of Technology, Institute of Thermal Engineering (Austria).
Partners:

- Carbon Compass (Austria)
- EKASI Energy (South Africa)
- Tshwane University of Technology (South Africa)
- Institut Mines Telecom IMT Mines Albi (France)
- Makerere University (Uganda)
- University Carlos III de Madrid (UC3M)(Spain)

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project used a rigorous and multidisciplinary approach combining CFD modelling, laboratory experiments, fuel and emission analysis, field testing, LCA, digital monitoring, and socio-economic studies. It successfully developed a multifuel TLUD stove achieving over 40% efficiency with low emissions and created a database of 51 African biomass fuels. The TEG system did not reach its 6 W target and was replaced by a more reliable PV-battery solution. The project also contributed to capacity building through joint research and workshops. However, the report provides limited details on field-test sample sizes, statistical methods, measurement uncertainty, long-term validation, and the number and skills of people trained.

2) *PROJECT OUTCOMES & IMPACT*

Overall, the project represents a valuable and innovative contribution to clean cooking and off-grid energy, with strong scientific achievements and promising economic, social, and environmental benefits. Its main strengths are its multidisciplinary approach, technological innovations, knowledge dissemination, and positive impacts on women and local communities. However, the impact remains partly limited by the lack of detailed statistical, gender-disaggregated, and long-term socioeconomic data, as well as the absence of patents, licenses, or spin-offs. Some scientific publications are also still pending. Nevertheless, the project successfully achieved most of its objectives and provides a strong foundation for further research and practical implementation.

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

3) *PLANNING, COORDINATION, COLLABORATION*

The project was initially well planned, with clear work packages, responsibilities, milestones, and risk management. Although funding delays, communication difficulties, late recruitment, and technical challenges affected implementation and led to a nine-month extension, the consortium adapted effectively and completed most of its objectives. The division of tasks between European and African partners was appropriate and based on their respective expertise, enabling successful technology adaptation and field validation. The international collaboration was a major strength, facilitating knowledge transfer and providing valuable insights from field testing in Uganda. However, the project would have benefited from field testing in both African partner countries and better adherence to the original timeline. Overall, project management and international cooperation were satisfactory to highly successful despite some implementation challenges.

4) *OVERALL COMMENTS*

The SHE project is scientifically strong and relevant, addressing a clear need for improved solutions in rural and refugee communities throughout Africa. The main strength of the proposed project is the integration of various technologies and engineering solutions to address the identified problem. The project has yielded valuable results, including the creation of an efficient multifuel TLUD stove, a database of 51 biomass fuels from Africa, a PV-battery charging controller, a LoRaWAN-enabled dMRV sensor system, and financing models specific to each region. The consortium exhibited good scientific judgement in the abandonment of the TEG system in favor of the more affordable and reliable PV-battery system. Furthermore, field testing in Uganda of the SHE stove system added to the scientific and technical relevance of the project.

The project made a meaningful contribution to the research and innovation cooperation between the African and European Union. The European partners contributed research and infrastructural expertise to the African partners, and the African partners contributed knowledge and expertise regarding their region to the European partners. The project has developed integrated solutions regarding clean cooking, biomass fuels, off-grid electricity, digital carbon monitoring, and financing. The research activities and the workshop at Makerere University have helped to transfer knowledge and develop innovation within the African scientific community. Additionally, the preparation of a follow-up proposal indicates the potential for the African and European scientific communities to continue their

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partnership. However, the number of researchers that were trained during the project is not quantified.

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3. END OF LIFE AND RECYCLING TOPIC

This topic was addressed by three projects aiming to explore recycling opportunities of batteries and solar PV.

The projects are focused on technologies of recycling and materials valorisation analysing the perspectives of industrial development.

- RCLIB (call 2023)
- RESTART (call 2022)
- SIREVIVAL (call 2022)

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

RCLIB

RCLIB: Recycling of the cathodes, based on carbon nanotubes and conducting polymers, from spent rechargeable Li batteries

Coordinator: National Institute of Materials Physics (Romania).

Partners:

- IT Center for Science and Technology (CITST) (Romania)
- Badji Mokhtar University (Algeria)
- Istituto Nazionale di Fisica Nucleare (Italy)
- University Cadi Ayyad (Morocco).
- Mohammed VI Polytechnic University (UM6P) (Morocco)

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The methodology is generally strong and builds on established previous work, using appropriate analytical techniques to study and reprocess materials from spent batteries and related composites.

However, some of the reported performance results raise concerns, as a few key numbers are not fully consistent with expected electrochemical behavior or are presented without clear normalization, which makes the strongest claims less reliable.

Despite these issues, the project was largely delivered as planned, with all work packages completed and new recycled-based materials successfully developed. It also generated useful scientific knowledge and contributed to capacity building through student training, international collaboration, and hands-on workshops involving both.

2) *PROJECT OUTCOMES & IMPACT*

The project includes a promising CNT-recovery technology that could add both economic and environmental value to existing battery recycling methods. It also identifies realistic industrial partners in both Europe and Africa, offering a step beyond traditional metal-focused recycling approaches. Dissemination results are generally strong, with several papers and conference presentations, although not all publications are finalized yet and one output is outside the main project scope.

Overall, the project also demonstrates a positive contribution to gender balance, with strong female representation in leadership roles, including the project coordination.

3) *PLANNING, COORDINATION, COLLABORATION*

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

The project was well structured, with clear work packages, tasks, and responsibilities distributed across all partners. However, it started later than planned, and the reporting does not fully cover the final phase of the project, leaving some uncertainty about the last stages of implementation.

Despite this, coordination between the six partners worked well, supported by regular communication and joint meetings, with strong participation across activities.

Overall, the EU-AU collaboration delivered clear added value, reflected in joint publications, training exchanges, and successful continuation of the partnership through a follow-on funded project.

4) OVERALL COMMENTS

The project benefits from a strong and well-balanced EU-AU consortium and a novel reuse approach that delivered promising technical results, including performance beyond the original supercapacitor target. It also led to a patent application and a follow-up funded project, showing clear continuity and impact.

Beyond the formal outputs, the project helped build strong and lasting research relationships between the Romanian/Italian and Moroccan/Algerian teams. This trust and collaboration are clearly reflected in the consortium's success in securing a new related LEAP-SE 2025 grant (RESZNC), which continues the partnership.

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RESTART

RESTART: REcycling of spent Li-ion batteries and end-life photovoltaic panels: From the development of metal recovery processes to the implementation of a START-up

Project coordinator: Cadi Ayyad, University UCA of Morocco
Partners:

- UM6P, Morocco
- GEP, Morocco
- KSIU, Egypt
- CEREGE, France
- BBU, Romania
- Aalto, Finland

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project demonstrates strong scientific quality and significant technological potential, with a comprehensive comparative approach covering the full recycling value chain from end-of-life LiBs and PV panels to material recovery, battery regeneration, scale-up, and techno-economic assessment. The methods appear appropriate and rigorously applied, supported by quantitative leaching, electrochemical, and economic data, with several results already validated through peer-reviewed publications. The project generated substantial new knowledge, particularly through the development and comparison of three demonstrated cathode-recycling routes and the integration of regenerated materials into new electrochemical applications. At final term, the project had achieved promising closed-loop recycling results, a dedicated PV-panel recycling process, a techno-economic assessment, patents, seven scientific publications, two PhD and five Master theses, and follow-up funded projects. However, the absence of a final report limits assessment of overall completion, reproducibility, full LCA/techno-economic validation, and achievement of all original targets. Capacity building was a clear strength, with seven young researchers trained, multiple theses completed, and the establishment of a UNESCO Chair on e-waste recycling. Overall, the available evidence indicates strong scientific and capacity-building achievements, with convincing proof-of-concept results, while industrial-scale validation and full assessment against the original milestones remain insufficiently documented.

2) *PROJECT OUTCOMES & IMPACT*

The project demonstrates strong scientific impact and promising economic potential, with seven publications, two patents, a quantified techno-economic assessment, and two follow-

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up funded projects supporting a credible pathway toward further development and market uptake. Its potential environmental and societal impact is also significant, given its contribution to circular LiB and PV-panel recycling, recovery of critical raw materials, and reuse of regenerated materials in new applications. However, in the absence of a final report, the extent to which these potential impacts have translated into real-world environmental, economic, or social benefits cannot be confirmed. The project shows substantial innovation and added value, particularly through the comparative development of multiple recycling routes, closed-loop validation of regenerated materials, and integration of techno-economic and business-development perspectives. Dissemination is evidenced by the scientific publications and patents, although broader communication activities and reach are not documented. The project also explicitly incorporated gender equality into its capacity-building objectives, targeting approximately 35% female participation, but no evidence is available to confirm whether this target was achieved. Overall, the project shows strong scientific and innovation potential with a credible route toward impact, while evidence of realised societal and economic impact remains limited.

3) PLANNING, COORDINATION, COLLABORATION

The project had a well-structured management framework in principle, with a dedicated coordination work package, clearly allocated responsibilities, and a logical distribution of tasks across the international consortium. However, the absence of a final report prevents a robust assessment of how effectively this structure was implemented, including coordination mechanisms, risk management, milestone achievement, and timeline compliance. The available documents also contain a minor inconsistency in the allocation of WP5 and WP6 responsibilities, while the apparent shift in the project period is not explained. The international collaboration nevertheless appears to have generated substantial added value, combining complementary African and European expertise, joint doctoral supervision, and broader international links through the UNESCO Chair on e-waste recycling. Overall, the planned management structure was sound and the collaborative potential was strong, but the available evidence is insufficient to confirm the effectiveness of project management and execution throughout the full lifecycle.

4) OVERALL COMMENTS

On the basis of the available documents, RESTART's main strengths are (i) a comprehensive, comparative development of at least three EoL-LiB metal-recovery routes with demonstrated results (plus a fourth, froth flotation), and a dedicated PV-panel recycling process, going beyond typical single-route lab studies; (ii) solid, externally validated scientific output (7 Q1 publications, 2 patents, including a patent filed with IRESEN); (iii) a closed-loop demonstration in which regenerated materials were successfully re-tested in both batteries and supercapacitors; (iv) explicit techno-economic (SEA tool) and life-cycle-assessment

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methodology applied to at least one route, going beyond a purely technical proof of concept; a clear, distinctive orientation toward implementation (start-up creation, SO3), supported by two follow-up funded projects; and (v) substantial capacity building (2 PhD theses, 5 Master theses, a new UNESCO Chair) plus an explicit, quantified gender-equality target in the proposal (7/20 members). The main limitations of this evaluation stem from the available documentation rather than necessarily from the project itself as without a final report, it is not possible to assess whether timelines/milestones were respected, how risks were managed, how effective day-to-day coordination was, what the dissemination reach was, or whether the SO2 recovery-rate target (>=1 kg/day) and the 7/20 gender target were achieved. Overall, the technical and scientific substance of RESTART, as documented, appears strong and well-validated.

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SIREVIVAL

SIREVIVAL: Si-based devices for renewable energy: From end of life recycling to revival of photovoltaic modules

Project coordinator: Université catholique de Louvain, Belgium
Partners:

- IEMN, France
- CRTSE, Algeria
- ENSIT, Tunisia
- CRTEn, Tunisia

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project demonstrated a scientifically sound and coherent approach linking PV recycling, advanced supercapacitor materials, device fabrication, and smart energy management. PV recycling exceeded its target, achieving >90% material recovery efficiency, supported by LCA results. The project also developed a validated self-healing PEG-based ionogel, fabricated and characterized 3D Pt/MnO_2 micro-supercapacitors using recycled Si substrates, and demonstrated a Fuzzy Logic Controller that reduced transient battery current by 50% under high shading. Six peer-reviewed publications, three workshops, and capacity-building activities involving young researchers further demonstrate meaningful scientific and training outcomes.

The supercapacitor results remained below several key targets: demonstrated voltage windows were only 1–1.6 V versus the >2 V objective, while evidence for the targeted energy density, cycle life, and operating-temperature range was not provided. Standardized validation was incomplete, and scale-up beyond TRL 4 was not achieved because additional resources were unavailable. Full integration of recycled materials into a complete smart energy system was therefore not demonstrated. Overall, the project achieved strong results in PV recycling and promising laboratory-scale advances in materials, supercapacitors, and energy management, but the transition toward validated, scalable technology remained incomplete.

2) *PROJECT OUTCOMES & IMPACT*

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

The project achieved clear scientific and dissemination impact, with six peer-reviewed publications, three workshops, extensive conference and workshop participation, and an estimated reach of around 800 people across scientific, civil-society, public, media, industry, and policy audiences. Its main innovation was the integration of PV recycling, self-healing ionogels, recycled-Si micro-supercapacitors, and intelligent PV-battery energy management into a single value chain, although this end-to-end concept was only partially demonstrated at final term. Broader economic, social, and environmental impacts remain largely potential rather than achieved, as the technology remained at low TRL, required further funding for valorisation, and had no reported patents or techno-economic assessment. The gender dimension was positively incorporated into the project design, and all peer-reviewed publications included at least one woman author, although no quantitative gender participation target was defined and the available evidence does not establish broader gender impacts. Overall, the project generated solid scientific and dissemination outcomes and meaningful technological innovation.

3) PLANNING, COORDINATION, COLLABORATION

The project had a well-structured management framework, with clearly assigned WP leadership, defined partner responsibilities, planned coordination mechanisms, risk assessment, and formal management deliverables. The stable organisational structure and completion of the three planned workshops indicate that the overall management framework was maintained. However, the available evidence is insufficient to confirm the effectiveness of day-to-day coordination, including the planned monthly meetings, risk-mitigation measures, issue escalation, and monitoring of milestones across all WPs. The unexplained shift in the project implementation period and the absence of equivalent milestone evidence for WP3 and WP4 further limit the assessment of execution against the original plan. By contrast, the international collaboration generated clear added value, through complementary expertise across Belgium, France, Algeria, and Tunisia, scientific visits, workshops, capacity building, and the creation of new research links, including a funded follow-up project and collaborations with additional African and European institutions. Overall, the project had a sound management structure and strong international collaborative added value, but evidence of effective operational coordination and execution is limited.

4) OVERALL COMMENTS

SIREVIVAL's main strengths are (i) PV-panel recycling efficiency of >90%, exceeding the proposal's >85% target, with LCA results cross-validated against two independent literature benchmarks; (ii) a novel self-healing, PEG-based ionogel electrolyte chemistry, successfully synthesized and characterized; (iii) working 3D interdigitated Pt/MnO2 micro supercapacitors

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fabricated from recycled Si and confirmed by SEM and electrochemical testing; (iv) a simulated hybrid PV-battery-supercapacitor smart energy system whose fuzzy-logic controller reduced battery transient current by 50% versus a classical controller and met the lower bound (300 s) of the project's overcast-coverage target; (v) 6 peer-reviewed publications; 3 realised workshops with substantial international dissemination reach; and (vi) new collaborations initiated with partners in Kenya, South Africa and Germany, alongside a funded follow-up project (RESZNC). Several limitations are also documented in the sources themselves rather than added by this evaluation as (i) the fabricated supercapacitors reached only 1 V (aqueous electrolyte) and 1.6 V (ionic-liquid electrolyte), both below the proposal's >2 V KPI target, and no figures are given for the energy-density (>20 Wh/kg), cycle-life (>10^5 cycles) or operating-temperature-window KPIs; (ii) the PEDOT:PSS-aerogel milestone was reached but explicitly flagged as not meeting the expected endproduct quality, described as the project's first major bottleneck; (iii) SC scale-up was explicitly reported as not achieved due to resources not secured during the project; the consortium reports it did not reach critical mass to move its technologies beyond TRL 4; and (iv) the project's own valorisation assessment states it has a low technological readiness level requiring further funding, with no patents reported. A budget that was limited and not flexible for almost all partners is also named as a difficulty. One further point should be flagged rather than resolved as the final report states the smart-energy-system simulation was carried out in a Matlab-Simulink environment, while the presentation's corresponding slides are explicitly titled Software (Open Modelica) and show what appear to be OpenModelica model diagrams; the documents provided do not explain this discrepancy in the stated simulation software. Overall, SIREVIVAL shows well validated results in its recycling work package and credible progress in materials and device fabrication, while the supercapacitor performance and system-scale-up objectives remain only partially met against the proposal's original KPIs, as the project's own documents acknowledge.

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4. DIGITAL TOOLS FOR SMART GRIDS AND STAND ALONE SYSTEMS TOPIC

Digital tools are more and more used in energy research projects as, for example, digital twins allowing to modelize and analyse the behaviour of complex energy systems. The projects identified in this topic are relying on digital tools beyond simulation and propose wider applications.

The stability of electricity grids either regarding minigrids or end of line national grids is addressed by those projects.

Artificial intelligence will play a major role in grids performance as well for the energy supply and demand balance as for the distribution maintenance. The use of satellite data and AI will also allow to enhance renewable energy systems and planning.

- MIDINA (call 2023)
- OASES (call 2022)
- SWITCH (call 2023)

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

MiDiNa

MiDiNA: A comprehensive methodological approach on the development potential of microgrids and the integration of renewable energies in North Africa.

Coordinator : Institut de Recherche en Energie Electrique de Nantes Atlantique (France).
Partners:

- Université de M'sila (Algeria)
- Technical University of Cluj Napoca (Romania)
- Université Sidi-Mohamed Ben-Abdellah (Morocco)
- Université Mohammed V Souissi (Morocco)
- Atlykas Groupe (Morocco)
- AOUINA KAMEL (Algeria)

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

A rigorous, interdisciplinary methodology combining technical, economic, and social research were employed by the project to address microgrid deployment challenges in North Africa. On the technical side, the project developed techno-economic models for optimal microgrid sizing using real field data, advanced control algorithms (such as the Integral Super-Twisting Algorithm), and AI-based cyber-physical resilience frameworks tested against simulated cyber-attacks.

The models and tools developed were validated through smart-house demonstrators in Algeria, hardware-in-the-loop platforms in Morocco, and test benches in Romania, supported by sensitivity analyses and peer-reviewed publications that confirmed scientific rigour. In parallel, structured socio-economic surveys, including a two-phase study of 189 households in Algeria assessed local knowledge, attitudes, and barriers to renewable energy adoption, with comparative analyses benchmarking findings against European contexts to ensure reliability and validity.

The project generated substantial new knowledge, including novel game-theory-based peer-to-peer energy trading models (Hawk–Dove strategies), AI-driven forecasting and coalition formation tools, and comparative insights into renewable energy adoption drivers across Algeria and Romania.

Although administrative delays related to funding and agreements pushed the timeline to an extension until March 2026, all major work packages were successfully completed, delivering

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results on optimal sizing, resilient control, cooperative management, and socio-economic analysis, along with all planned demonstrators.

Beyond its technical and scientific outputs, the project made a significant contribution to capacity building by strengthening African academic partners' institutional and human capacity through training, workshops, and joint research, and by disseminating findings to over 500 members of the scientific community thus positioning the project as scientifically sound, methodologically rigorous, and impactful for both research and future capacity development.

2) PROJECT OUTCOMES & IMPACT

The project's scientific impact appears substantial and multi-dimensional, spanning technical, economic, and social domains. On the technical side, the MiDiNA research project produced validated optimal-sizing models for arid-region microgrids, a robust Integral Super-Twisting control algorithm, and an AI-based cyber-physical resilience framework tested against False Data Injection attacks. Contributions with clear economic potential given demonstrated cost reductions (e.g., a 6.4% lifetime-cost drop using Dynamic Thermal Rating transformers, and up to 20.5% cost differentials between configurations).

Socially and culturally, the project's 189-household survey in Algeria and comparative Algeria–Romania analysis generated original insight into local attitudes toward RE adoption, including the finding that nearly all respondents (94.4% in Algeria, 100% in Romania) consider state aid essential to adoption. This evidence has direct relevance to future energy policy design in North Africa. The ministerial visit to the M'sila University smart-house demonstrator and coverage by national/local media further indicate the project achieved visibility and perceived relevance beyond the academic sphere.

The extensive dissemination is well-documented with the consortium reporting 24 listed publications, including peer-reviewed journal articles in venues such as Applied Energy, Applied Sciences, Energy and Buildings, and Electronics, alongside numerous IEEE conference papers and a book chapter. Beyond publications, the team organized multiple workshops, participated in 14 conferences and 3 workshops, and reached an estimated 500+ scientific community members, 100+ general public members, and 6 media outlets. The dissemination was actively realized at a meaningful scale.

The project demonstrates genuine innovation, particularly through its Hawk–Dove game-theory-based peer-to-peer energy trading model and its memetic-inspired coalition-formation strategy for microgrid energy markets. The integration of Dynamic Thermal Rating technology into transformer sizing decisions, and the combination of AI-based forecasting with blockchain-based peer-to-peer trading mechanisms, further reflect technically original work rather than incremental application of existing methods. The added value is amplified by the project's interdisciplinary design, which is explicitly linking WP1 (technical sizing) with WP4

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(socio-economic behaviour) to produce dimensioning strategies informed by real adoption data, which the report itself frames as a source of "particularly new insights."

Unfortunately, the report does not provide explicit evidence addressing gender balance within the consortium, the survey sample, or the societal impact of the technologies deployed although in the pictures provided there are females probably researchers. This is despite being a required criterion.

3) PLANNING, COORDINATION, COLLABORATION

Project planning and organization were reasonably effective overall, though significantly tested by administrative bottlenecks. The coordination team adapted by extending the administrative end date from the original schedule to 31 March 2026 (a 34-month duration), and the report notes that momentum was "re-launched" once Romanian funding was confirmed, suggesting responsive rather than purely reactive management.

Coordination among the six-partner consortium (Nantes Université as coordinator, M'sila University, TUCN, USMBA, UM5R, and industrial partner Aouina Kamel) appears well-structured, with clear work package ownership and deliverables produced largely on schedule (e.g., D3.1 and D3.2 released without significant delays). The report describes a "good rhythm of meetings and exchanges".

Timeline management was moderately efficient but clearly strained. While all major technical milestones were ultimately met or nearly met such as optimal sizing models, resilient control validation, cooperative trading algorithms, and the completed field survey; the project needed a formal extension due to compounding administrative delays since funding confirmations were trailing for some partners, and the consortium agreement signature lagging nearly to the project's end. Content-based milestones seemed to have been met even as procedural/administrative timelines slipped.

The added value appears genuinely strong and well-evidenced rather than just asserted. Concrete cross-regional outputs include the interdisciplinary WP1–WP4 interaction, comparative Algeria–Romania survey data on renewable energy adoption and state-aid expectations, joint AU–EU publications and workshops, and shared demonstrator infrastructure (smart-house in Algeria, HIL platforms in Morocco and Romania) explicitly intended to serve as long-term platforms for African partners' research capacity. The ministerial visit to the Algeria demonstrator and the emerging LEAP-SE follow-on project further indicate that the collaboration generated durable institutional value beyond the project's technical deliverables.

4) OVERALL COMMENTS

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

Overall, the MiDiNA research project is a scientifically solid and genuinely productive project that has delivered on its core technical and socio-economic objectives despite considerable administrative headwinds.

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OASES

OASES: Development and Demonstration of a Sustainable Open Access AU-EU Ecosystem for Energy System Modelling

Project coordinator: Fraunhofer Institute for Energy Economics and Energy System Technology, Germany

Partners:

- University of Kassel, Germany
- VTT, Finland
- CSIR, South Africa
- UNIVEN, South Africa
- Helwan University ,Egypt
- CDER (and CEREFE1), Algeria

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project successfully combined advanced satellite-image analysis, high-resolution weather data processing, and energy system modelling into a practical framework tailored to African and European energy contexts. Using state-of-the-art AI methods, it achieved highly accurate detection of solar PV and wind installations, produced reliable renewable energy time series datasets, and enhanced the IRENA FlexTool for local planning needs. The project delivered several open-source tools, datasets, and case studies across Africa, contributing valuable new knowledge on renewable energy mapping and modelling. Despite some limitations caused by the withdrawal of one project partner, all major objectives were achieved, and strong capacity-building efforts- including workshops, tutorials, and user-friendly tools- helped ensure broad uptake and lasting impact.

2) PROJECT OUTCOMES & IMPACT

The project has generated significant scientific and practical impact by producing high-quality research outputs, open datasets, and accessible tools that support evidence-based energy planning across Africa. Through publications, conference presentations, and open-source resources, the project has ensured broad dissemination and long-term accessibility of its results. Its main innovation is the creation of a seamless, open, and replicable workflow that links satellite-based renewable energy mapping with resource assessment and energy system planning, tailored to the realities of African data environments. The project also promoted

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gender diversity, with women representing 40% of the team, while highlighting the need for greater female representation in leadership roles in future initiatives.

3) PLANNING, COORDINATION, COLLABORATION

The project benefited from strong planning, effective coordination, and productive international collaboration throughout its duration. A well-organized management structure, regular consortium meetings, and monthly coordination sessions ensured smooth communication, timely decision-making, and successful delivery of all major milestones. Responsibilities were clearly distributed among partners, and challenges arising from one partner's reduced participation were managed without affecting overall project progress. The collaboration between African and European institutions proved particularly valuable, bringing together advanced technical expertise with local knowledge, data, and practical insights to create solutions that are both scientifically robust and relevant to real-world needs.

4) OVERALL COMMENTS

The OASES project successfully achieved its main scientific and technical goals, delivering valuable open-source tools, data, and knowledge for the AU-EU renewable energy community.

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

SWITCH

SWITCH: Stabilizing weak grids through machine learning: empowering farmers in end-of-line communities in North Africa through artificial neural networks

Coordinator: Technische Hochschule Ingolstadt (Germany).

Partners:

- Women Engage for a Common Future WECF (Germany)
- University of Adrar (Algeria)
- University of Ain Temouchent (Algeria)
- AI Town S.R.L (Italy)
- Al Akhawayn University (Morocco)
- University Mohammed Premier (Morocco)
- Institut National des Postes et Télécommunications (Morocco).

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project used a relevant multidisciplinary approach combining Agri-PV, batteries, smart grids, machine learning, and agriculture. However, limited electricity and outage data prevented full implementation and validation.

The research was scientifically relevant but had to be adapted due to the lack of outage data. It therefore provides mainly a proof of concept rather than a complete solution.

The methods were generally appropriate, using smart meters, surveys, MATLAB, and machine learning. However, limited data and insufficient model validation reduced the methodological rigor.

The results are partially reliable, mainly because of the small Algerian dataset and incomplete Moroccan data. The tools and models are useful, but the proposed systems were not fully validated in real conditions.

The project provides a new integrated approach combining Agri-PV, storage, machine learning, agriculture, and grid management. It produced useful tools, datasets, and models, although mainly at proof-of-concept level.

The project made significant progress but did not fully achieve its initial objectives. Funding, visa, data-collection, and diplomatic issues affected implementation and collaboration.

The main outputs were datasets, Agri-PV sizing tools, the PERSOLE platform, business and regulatory models, and training materials. However, full system and grid-integration validation was not achieved.

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The project strengthened technical knowledge and cooperation through training and knowledge transfer in renewable energy, energy management, financing, and cooperation. However, long-term impacts have not yet been demonstrated.

2) PROJECT OUTCOMES & IMPACT

The project generated relevant scientific and potential economic and social impacts through its integration of Agri-PV, battery storage, machine learning, and agricultural needs. Its results were disseminated through publications, conferences, workshops, and digital platforms. The main innovation lies in combining energy and agricultural requirements in open-access tools such as MATLAB and PERSOLE, although the original goal of fully predicting power outages was not achieved. The project also strongly promoted gender equality through training and female participation, but its long-term impact on women's economic empowerment and decision-making remains unproven.

3) PLANNING, COORDINATION, COLLABORATION

The project was initially well planned and structured, with clear work packages and regular coordination meetings. However, unexpected risks such as funding delays, visa issues, licence problems, and political restrictions affected implementation. Timelines and milestones were not fully respected, leading to a project extension, although most key outputs were eventually delivered. International collaboration generated valuable scientific, technological, and capacity-building benefits, but its full potential was limited by political barriers, weak partner integration, and the absence of joint physical meetings.

4) OVERALL COMMENTS

Overall, SWITCH is a relevant and ambitious project addressing a significant challenge for rural end-of-line communities in North Africa. SWITCH has considered various aspects of the problem, such as agrivoltaics, battery storage, artificial intelligence, business models, policy analysis, and the development of the project's components and outputs. The project did develop an outage prediction model, but it had to adapt to the problem of the unavailability of grid fault data in the countries in which it was to be implemented. The creation of the MATLAB-based Agri-PV sizing tool and the PERSOLE platform indicates the project's commitment to creating DORA components such as software, data, and research outputs. The collaboration between African and European institutions indicates the project's efforts to form partnerships and increase expertise within the project. However, there are some weaknesses to the SWITCH project. The project did not collect the necessary data from the

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intended number of countries for the length of time required to evaluate the project's success. Furthermore, the project only partially completed some of the components of the proposed plan, and it did not achieve the original goal of evaluating agrivoltaics in two North African countries. Some of the reasons for the incomplete components of the project include funding problems, visa issues for experts, political tensions between the countries, and the integration of some partners into the SWITCH project. Additionally, the benefits of the SWITCH project that the team proposed are all prospective, as the project did not complete trials to confirm the project's impact. Thus, SWITCH is a promising project with useful and impactful components and outputs, but the project has yet to exhibit its full potential and to demonstrate that it has the impact that it claims to have.

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5. PRODUCTIVE USES IN AGRICULTURE AND OTHER APPLICATIONS TOPIC

This topic covers a large scope of renewable energy applications : agriculture, sanitary, mobility.

The projects identified in the topic aim to develop performant uses of renewable energy and to enhance local productive revenues for population.

Several projects address the Water Energy Food Nexus and PV Agri (MG-FARM, OPTIMG, REPTES, Smart APV Fruit) while other are dedicated to specific applications such as water purification (LEDSOL) or electric mobility (SolaChargE) with solar energy.

Field experimentations allowed to develop business models.

- MG-FARM (call 2022)
- LEDSOL (call 2022)
- OPTIMG (call 2023)
- REPTES (call 2023)
- Smart APV Fruit (call 2023)
- SolChargE (call 2022)

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MG-FARM

MG-FARM: Smart stand-alone micro-grids as a solution for agriculture farms electrification

Project coordinator: Université de Lorraine, France
Partners:

- Université de Lorraine (ULGREEN), France
- IECORP SA, France
- TU Berlin (TUB-WIP), Germany
- TU Berlin (TUB-EET), Germany
- MicroEnergy International GmbH (MEI), Germany
- Université de Tlemcen, LAT (UT), Algeria
- CDER-UDES,
- IRESEN-Green Energy Park (GEP), Morocco
- International Univ. of Rabat (UIR), Morocco
- Ecole Nationale des Sciences Appliquées d'Oujda (ENSAO), Morocco

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The MG-FARM project demonstrates strong scientific soundness through its interdisciplinary methodology, combining advanced modelling, real-time data collection, Internet of Things (IoT), Artificial Intelligence (AI), and blockchain technologies to optimize smart microgrids for sustainable agriculture in Algeria and Morocco.

The research methods are appropriate and rigorously applied, as evidenced by the development and experimental validation of laboratory and pilot farm prototypes, comprehensive stakeholder analyses, and numerous peer-reviewed publications (7 journal papers, 13 conference papers, 3 book chapters, 1 conference organized).

The results are fairly reliable and valid, with experimental data confirming the stability and effectiveness of the microgrid systems under real-world conditions, and findings published in reputable journals.

The project contributes significant new knowledge to the field, particularly in decentralized energy management, integration of renewable energy in agriculture (the water-energy-food and resilience nexus), and the use of digital platforms for farm optimization.

While some delays are reported from equipment procurement and personnel changes, the project largely progressed according to its initial milestones, recovering from setbacks and achieving key deliverables.

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Main results at the final term include the installation and validation of digitized microgrids and smart storage systems at pilot farms, the creation of digital training platforms (AgriConnect and Agrigent), and the establishment of a comprehensive data and control infrastructure.

The project has also made substantial contributions to capacity building, training PhD students, postdocs, and numerous interns, and providing hands-on training and digital tools to farmers and stakeholders, thereby fostering local expertise and supporting sustainable rural development.

2) PROJECT OUTCOMES & IMPACT

The MG-FARM project has delivered substantial scientific, economic, social, and cultural impacts. Scientifically, it advanced the integration of smart microgrids, renewable energy, IoT, AI, and blockchain for sustainable agriculture

Scientific outputs of the project include peer-reviewed publications, conference presentations, and open-access resources have been provided. They have reported 7 journal papers, 13 conference papers, 3 book chapters, 1 conference organized. These outputs have been widely disseminated through international conferences, workshops, and media, reaching academic, industry, and policy audiences.

Economically and socially, the project enabled the deployment of digitized microgrids and smart storage systems at pilot farms in Algeria and Morocco, improving energy and water management, supporting food and energy security, and fostering rural development. The project's innovations—such as the AgriConnect and Agrigent digital platforms, blockchain-based energy and water sharing, and AI-driven decision support offer significant added value by empowering farmers, enhancing resource efficiency, and creating new business models.

The international collaboration proved highly valuable, facilitating knowledge exchange and joint research, and leading to new project proposals and awards, such as the Solar Off-Grid Project of the Year in Algeria.

In terms of gender equality, the project promoted inclusion by involving female researchers in key roles, supporting gender and youth inclusion in training activities, and raising awareness of gender issues in rural development.

3) PLANNING, COORDINATION, COLLABORATION

The project demonstrated robust planning and adaptive management throughout its lifecycle. The project was structured around clear work packages, annual meetings, and regular deliverable tracking, with strong engagement from all partners.

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Coordination among team members and partners was facilitated by frequent virtual and on-site meetings, collaborative preparation of deliverables, and shared responsibilities within interdisciplinary teams, ensuring that tasks were well-aligned and communication remained effective despite some logistical challenges (such as equipment procurement delays and personnel changes).

Timelines and milestones were generally managed efficiently, with most deliverables issued around scheduled dates; minor delays, particularly in field measurements and equipment delivery, were transparently reported and successfully recovered.

The added value of international collaboration was highly satisfying, as the partnership enabled knowledge exchange, joint research, and the development of innovative solutions tailored to local contexts in both North Africa and Europe. This collaboration also led to the submission of new joint projects and the extension of the research network. Overall, the project's excellent organization, coordination, and international cooperation were key factors in achieving its ambitious goals and maximizing its impact.

4) OVERALL COMMENTS

Overall, the MG-FARM project's strengths in innovation, scientific rigour, and capacity building far outweigh its operational challenges, making it a model for sustainable rural development and energy transition in the region with immense societal benefits foreseen.

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LEDSOL

LEDSOL: Enabling clean and sustainable water through smart UV/LED disinfection and SOLar energy utilization

Project coordinator: Centrul IT pentru Stiinta si Tehnologie, Romania
Partners:

- Tampere University (TAU), Finland
- Laboratory of Applied Hydrology and Environment of University of Lomé, Togo
- Unité de Développement des Equipements Solaires /EPSTCentre de Développement des Energies Renouvelables (UDES / EPST- CDER), Algeria
- Institut für Sozialforschung und Sozialwirtschaft e. V. (ISO), Germany

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project successfully combined expertise in water treatment, solar energy, positioning technologies, and user-centered design to develop innovative and practical solutions for safe drinking water access. It delivered two validated prototypes, including a solar-powered portable backpack capable of producing safe drinking water in remote areas, while demonstrating strong technical performance under real-world conditions. Despite some logistical challenges, all major objectives were achieved, generating valuable scientific knowledge, practical innovations, and capacity-building outcomes that will support future Africa-Europe collaboration in water and energy research.

2) *PROJECT OUTCOMES & IMPACT*

The project delivered a practical and innovative solution for providing safe drinking water in off-grid communities, demonstrating both technical effectiveness and strong potential for real-world impact. It generated valuable scientific outputs, open-access tools and data, and attracted broad international attention. A particular strength was its focus on local needs and inclusive development, supported by strong female leadership and consideration of gender-related challenges in water access.

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3) *PLANNING, COORDINATION, COLLABORATION*

The project was well managed and benefited from strong collaboration between European and African partners, each contributing unique expertise. Despite funding and logistical challenges, the consortium adapted effectively, achieved its key milestones, and maintained good coordination throughout. The partnership created real added value by combining complementary skills and ensuring that the developed solutions were closely aligned with local African needs and contexts.

4) *OVERALL COMMENTS*

LEDSOL is a strong and well-executed project that successfully transformed an innovative idea into a validated and practical solution with clear potential for real-world deployment. The project combined technical excellence with a strong focus on user needs and effective dissemination, while also demonstrating the value of Africa-Europe collaboration. Some challenges remain, including limited user testing, technical improvements needed for the current prototype, and funding constraints that affected partner participation, but these do not diminish the project's overall achievements and future potential.

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OPTIMG

OPTIMG: Optimizing micro-grids for water-energy-food

Coordinator: Reiner Lemoine Institut (Germany).

Partners:

- University of Cape Town (South Africa)
- Tshwane University of Technology (South Africa)
- EnGreen Solutions (Italy)
- Green Energy Park (Morocco)
- Hassan II University of Casablanca (Morocco).

Evaluation :

1) SCIENTIFIC AND TECHNICAL OBJECTIVES

The project is scientifically sound and well structured, combining energy, water, agriculture, environmental, and socioeconomic aspects through open-source tools. The research methods were generally appropriate, but their validation remains incomplete due to limited methodological details, software bugs, and the absence of real-world mini-grid implementation. The results demonstrate feasibility for planning purposes but are not yet sufficiently validated for investment decisions. The project provides new knowledge by integrating the water-energy-food nexus into rural mini-grid planning. Significant progress was achieved, including 12 interviews, five case studies, and several open-source tools, although funding delays prevented full completion of the original schedule. Capacity building was also successful through workshops, research exchanges, and collaboration with African researchers, but some planned training activities remain incomplete.

2) PROJECT OUTCOMES & IMPACT

The project's main scientific contribution is an innovative planning framework integrating water, energy, and food needs into mini-grid design. It generated useful research, case studies, publications, and open-source tools, but the framework remains at the prototype stage and its real-world economic and social impacts have not yet been demonstrated. Dissemination was significant, although outreach to end users and policymakers was still incomplete. Gender equality was considered in the project's design, but there is insufficient evidence of a concrete impact on gender equality in society.

3) PLANNING, COORDINATION, COLLABORATION

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

The project was well planned and flexible, with regular meetings and effective coordination mechanisms. However, funding problems affected some partners, leading to task redistribution and delays. Most key milestones were achieved, but the project timeline was extended significantly and several activities remain incomplete. International collaboration generated strong added value through knowledge exchange, joint software development, and stakeholder input, although unequal funding and incomplete stakeholder involvement limited its full potential.

4) OVERALL COMMENTS

Overall, the OPTiMG project is relevant to science and aims to solve an important problem. Its strengths lie in the various analyses that have been performed, the development of the software components (WEFESiteAnalyst, WEFEDemand, WEFEConfigurator, and WEFEPlan), as well as the publications, pre-feasibility studies, workshops and research exchanges that have occurred as part of the OPTiMG project. Additionally, the consortium of OPTiMG has exhibited strength and resilience even despite delayed or unavailable funding for several of its partners. The international make-up of the OPTiMG consortium presents another of its important strengths. The consortium brings together expertise in energy, water-energy-food systems, agriculture, software production and African contexts. Moreover, the open-source character of the project promotes its contextual relevance to these different contributors. However, there are some weaknesses to the OPTiMG project. Most notably, the project significantly deviated from the original timetable for implementation due to funding delays, the absence of available funding for the Italian partner, and consequently, the reassignment of tasks to the RLI partner. Furthermore, as a result of this delay, several work packages were delayed. For instance, the OPTiMG workshops and activities have not yet been completed. Moreover, there are inconsistencies in the documents regarding the exact length of the OPTiMG project and its intended state of completion. A second area of weakness for the OPTiMG project is that the technical results are not yet mature. The software concept has been demonstrated, but the technical software WEFEPlan has only reached TRL 4-5, which was below the target. The presentation of WEFEPlan's current state includes descriptions of bugs, non-functional configurations, incomplete modeling of the components, and a need for further validation of the system. Thus, the technology is still in its early stages of development and is not yet ready for deployment. The project has yet to exhibit its intended economic, social and environmental impacts. Specifically, the mini-grids have not yet been implemented and consequently can not yet be monitored for impacts. In addition, while the project intends to include the consideration of gender equality, there is no data regarding the sex-disaggregated participation in the projects, limiting any ability to discuss its contribution to gender-equal societal development. In sum, the OPTiMG project has several positive aspects, such as the scientific relevance of the project, the innovation of the open-source software, the methodology used, and the international cooperation between the OPTiMG consortium members. However, these positive aspects must be qualified by the weaknesses of the

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project's deviations from the original plan, the incomplete activities, the technical immaturity of the software, and the lack of demonstrated impact. Despite the weaknesses of the OPTiMG project, the project has laid the foundation for the research and development of these tools. Further development of the software to address the noted weaknesses will allow for the OPTiMG tools to have their intended long-term impacts on the development of mini-grids in Africa.

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REPTES

REPTES: Renewable plants integrated with pumped thermal energy storage for sustainable satisfaction of energy and agricultural needs of African communities

Coordinator: University of Cagliari (Italy).

Partners:

- Smart City Instruments (Italy)
- University of Liege (Belgium)
- Green Energy Park (Morocco)
- Ecole Nationale Supérieure d'Arts et Métiers Rabat – UM5 (Morocco)
- Ecole Nationale Supérieure des Mines de Rabat (Morocco)
- Federal University of Petroleum Resources Effurun (Nigeria)
- Bucharest University of Economic Studies (Romania).

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project used a scientifically sound and ambitious approach combining Pumped Thermal Energy Storage PTES, renewable energy, agriculture, cooling, desalination, and green ammonia. The methods were rigorous, including modelling, experiments, techno-economic and life-cycle analyses, but the complete system was not validated at full scale. Results provide a credible proof of concept, although they remain based mainly on simulations and prototypes and are not yet sufficient for investment decisions. The project generated new knowledge on adapting PTES to African agricultural needs and produced models, case studies, a cooling prototype, and scaling guidelines. Most objectives were achieved, but the project took longer than planned and did not reach the targeted technology readiness level. It also contributed to capacity building and knowledge transfer between European and African researchers, although the impact on individual researchers was not fully documented.

2) *PROJECT OUTCOMES & IMPACT*

The project achieved significant scientific impact by advancing PTES for renewable energy systems serving African farms, with potential benefits such as lower electricity costs, reduced CO_2 emissions, cooling, heating, desalination, and food preservation. Results were widely disseminated through conferences, publications, workshops, and media, with one journal article published and a patent application submitted. Its main innovation is the integration of renewable energy, storage, and multiple end uses, supported by models, prototypes,

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assessment tools, and deployment guidelines. However, the technology remains at an early maturity level (TRL 4–5), and its full impact still needs to be demonstrated at scale. Gender equality was considered in the project design, but concrete outcomes and evidence of its implementation were insufficient.

3) PLANNING, COORDINATION, COLLABORATION

The project was well organized and most scientific activities were successfully completed, but funding delays between countries affected the initial schedule and required task reallocation. Coordination among partners was effective despite differences in methods, assumptions, and funding timelines. The project lasted 33 instead of 24 months, but all major objectives were achieved. The international collaboration added significant value through joint research, publications, training, a patent, and a follow-up project, although future success depends on effective prototype implementation.

4) OVERALL COMMENTS

REPTES is a scientifically ambitious and well-structured project investigating energy storage and productive uses of renewable energy in Africa. The integration of PTES with renewable energy generation, storage in batteries, cooling systems, desalination, and the production of green ammonia represents the main strength of the project. -The inclusion of four case studies in Morocco and Nigeria allows for a detailed investigation of several scales and applications of the technology. -The integration of thermodynamic, experimental, economic, life cycle, and business modelling significantly contributes to the overall value of the project. -The project has resulted in modelling tools, a solar-powered cooling prototype, publications, a patent application, and a follow-up project. -The international collaboration between African and European institutions was productive throughout the project. However, it took nine months to implement the project due to funding and administrative procedure differences between the African and European nations involved. The majority of the results from the integration of PTES with other technologies are based on simulations and experimental tests of the individual components of those technologies. Furthermore, while the predicted impacts of the technology on the economy, society, the environment, and gender are all promising, they have yet to be demonstrated in the communities that will benefit from this technology. Overall, REPTES provides a strong proof-of-concept foundation, but further prototype validation, stakeholder uptake, and impact monitoring are required.

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Smart-APV Fruit

SmartAPV-Fruit: Smart Agrivoltaic Systems for Fruits

Coordinator: Fraunhofer Institute for Solar Energy Systems ISE (Germany).

Partners:

- University of the Western Cape (South Africa)
- FruitsRouges & Co (Agri. coop.) (France)
- INRA National Institute of Agricultural Research (Morocco)
- Université Ibn Zohr, Agadir (Morocco)
- Cadi Ayyad University Marrakech (Morocco)
- Insolight (Switzerland).

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project was scientifically sound and used appropriate interdisciplinary methods combining agronomy, energy, water, modelling, monitoring, and economic analysis. Results were credible and showed 18–24% water savings and an 8°C reduction in soil temperature, although the lack of statistical analysis limits the strength of the conclusions and further large-scale testing is needed. The project generated useful new knowledge on optimal shading for berry crops, with moderate shading (~23%) generally performing better than heavier shading. Despite changes from the original plan, two main pilot systems were successfully developed, and the project achieved its key objectives. It also supported capacity building and knowledge exchange between African and European partners, although these impacts were not sufficiently quantified.

2) *PROJECT OUTCOMES & IMPACT*

The project had significant scientific and practical impact by demonstrating the potential of agrivoltaics for sustainable berry production in arid and semi-arid regions. It could reduce irrigation and energy costs, improve farm resilience, strengthen food and energy security, and support more sustainable resource management. Results were widely disseminated through presentations, workshops, conferences, stakeholder activities, and educational materials, although evidence of scientific journal publications was limited. The project was innovative in combining agrivoltaics with precision agriculture, water management, photovoltaic optimisation, and modelling, while adapting these technologies to African conditions. Its

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contribution to gender equality was mainly indirect, as women and men participated in the research team, but no specific gender-related strategies or outcomes were demonstrated.

3) PLANNING, COORDINATION, COLLABORATION

The project was well planned and effectively managed, with clear governance structures, defined work packages, regular meetings, reporting tools, and online collaboration. Tasks and responsibilities were appropriately distributed according to each partner's expertise, enabling effective cooperation between research institutions, universities, and industry. Although the project required an extension and the industrial pilot was relocated from Morocco to France, the consortium adapted well and successfully completed its main activities and objectives. The international collaboration generated significant added value by combining expertise in photovoltaics, agronomy, engineering, modelling, and socio-economic aspects, while supporting technology and knowledge transfer between Europe and Africa and creating opportunities for future research and innovation.

4) OVERALL COMMENTS

Overall, the project can be considered successful and valuable from a scientific standpoint. The project included a variety of different aspects of the Water-Energy-Food nexus, included collaboration between different European and African countries, and successfully implemented the agrivoltaic pilots both research and industrial. The project yielded valuable results regarding water savings, energy production, climate control for the crops, and the resulting performance of those crops. Furthermore, the project was successful in transferring knowledge and building the scientific and technical capacities of the participating individuals, which ensures that the project can be replicated in Africa in the future. Despite the successes of the project, however, there are some weaknesses to the project. The industrial agrivoltaic pilot was moved from Morocco to France, limiting the number of ways in which the technology could be directly validated against the conditions of Morocco's industrial areas. Furthermore, the project was extended beyond its original time schedule, and there were insufficient details regarding the statistical analyses of the project, the means of replicating the project, peer-reviewed scientific publications describing the project, and the outcomes of the described capacity-building component of the project. Despite these weaknesses, though, the project succeeded in achieving its objectives, and has laid the foundation for future agrivoltaic research and implementation within Africa.

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SolChargE

SolChargE: Decentralized Solar Charging System for Sustainable Mobility in rural Africa

Project coordinator: Technical University of Munich, Germany
Partners:

- Stellenbosch University, South Africa
- Adama Science and Technology University, Ethiopia
- Commissariat à l'énergie atomique et aux énergies alternatives CEA, France

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project generated credible and quantified results in electric agricultural mobility and rural electrification. The TCO analysis showed electric tractors operating 7.2–21% cheaper per hour than diesel equivalents in the analysed German and Rwandan cases, while the Rwanda electrification model showed a substantial reduction in median LCOE when agricultural demand was incorporated. The project also produced the TUMtrac electric-tractor demonstrator, more than four journal publications, two PhD theses, over 24 Bachelor/Master theses, student exchanges, and dissemination through conferences and Agritechnica. These outputs demonstrate meaningful scientific knowledge generation and strong capacity-building achievements.

The main limitation is the limited evidence that the project's core proposed innovation was achieved. The documented results focus predominantly on the electric-tractor strand rather than the second-life-battery SASCS and aCar-based Decentralized Transport Hub. Only one demonstrator is reported against a target of two, with no confirmation of second-life battery sourcing, SASCS performance, aCar integration, circular business-model development, or the planned environmental and social life-cycle assessments. The use of Nigeria and Rwanda rather than the proposed South Africa and Ethiopia cases is also unexplained, while the apparent shift in technical focus and project-period change are not documented. Overall, the project achieved substantial results in the tractor-economics and electrification strand, but important elements of the original project concept remain insufficiently demonstrated.

2) *PROJECT OUTCOMES & IMPACT*

The project generated clear scientific and technological outputs within the electric-tractor strand, including more than four journal papers, two PhD theses, over 24 Bachelor/Master theses, and dissemination through conferences and Agritechnica. The TCO analysis demonstrated that electric tractors could be cost-competitive with diesel alternatives in the

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analysed German and Rwandan cases, while the Rwanda electrification model showed a reduction in modelled LCOE from 0.56 to 0.16 $/kWh when agricultural demand was included. The purpose-built TUMtrac demonstrator, with a modular platform and swappable battery, also represents a concrete technological innovation.

Evidence of broader economic, social, environmental, and cultural impact is limited, as the Ethiopia pilot is documented only as a physical site without demonstrated community-level outcomes. The project's central circular-economy innovation is also not fully evidenced, since the demonstrator's batteries are not confirmed as second-life or locally produced. Dissemination reach and implementation of the planned communication activities are not documented. The gender objective is particularly difficult to assess: although a 50% female-participation KPI and explicit gender-related objectives were established, no gender-disaggregated results are reported, and all four listed partner contacts are male. Overall, the project achieved meaningful scientific, educational, and technological outputs, but evidence of wider realised impact and achievement of its gender and circular-economy objectives remains insufficient.

3) PLANNING, COORDINATION, COLLABORATION

The project had a clear and well-designed management framework, with defined WP ownership, regular coordination meetings, project-management tools, and milestone-based reviews. However, the effectiveness of its implementation cannot be fully assessed because no final report or milestone/deliverable status information is available, and the documented shift in the project period is unexplained. Partner roles were clearly allocated and the consortium was structurally complementary, combining expertise in EV engineering, PV systems, second-life batteries, rural electrification, and African implementation contexts. Achieved collaboration is evidenced by at least one joint publication and a South Africa–Germany student exchange. Overall, the project had a strong management and partnership design, but evidence of effective execution, milestone control, and full consortium-level collaboration remains insufficient.

4) OVERALL COMMENTS

The project shows a genuine, well-evidenced research strand on electric-tractor economics and rural electrification planning. A parametric total cost of ownership model showing electric tractors already cost-competitive with diesel equivalents (7.2% cheaper in Germany, 21% cheaper in a Rwandan case), a national scale finding that adding agricultural mechanization demand to least cost electrification planning can substantially lower electricity costs for all consumers, a purpose built tractor demonstrator (TUMtrac) with a swappable battery, and a solid capacity-building record (2 named peer-reviewed publications of a stated 4+, 2 PhD theses, more than 24 bachelor/master theses, a South Africa-Germany student exchange, and presentations including at the international Agritechnica trade fair). At the same time, this

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visible output differs notably from the proposal's central innovation concept a Stand-Alone Solar Charging Station built solely from second-life EV batteries, paired with TUM's existing aCar multipurpose EV, to form a Decentralized Transport Hub addressing market access, school access and healthcare access in South Africa and Ethiopia. Only one demonstrator is shown (the proposal's KPI called for two SASCS demonstrators), its battery is not confirmed as second-life or locally produced, and the Ethiopia Pilot Hub is documented only with an aerial photo and a video link, without performance, usage or user-feedback data. The presentation also documents almost no visible output from three of the four consortium partners (SBU, ASTU, CEA) individually, beyond one joint TUM-SBU publication their specific contributions to the SASCS, DTH implementation, and circular business model cannot be assessed from the documents provided. Whether this reflects an agreed shift in project scope, or simply that this particular presentation reports only one strand of the consortium's work, cannot be determined from the sources available. Overall, SolChargE's evidenced results are strong but narrower in scope, and less completely documented, than the proposal's original multi partner Decentralized Transport Hub concept.

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6. NEW RENEWABLE ENERGY SOURCES AND GREEN HYDROGEN TOPIC

This topic gathers 4 projects focused on new renewable energy sources and conversion technologies :

- 2 projects on hydrogen : HyAfrica aiming to assess natural hydrogen potential in Africa and D3T4H2S developing new technologies for hydrogen storage.
- 2 projects on advanced PV cells particularly adapted to African context

Natural hydrogen is a renewable carbon free resource of hydrogen which get an increasing interest at world level including in Europe. HyAfrica aims to identify natural hydrogen potential in several African countries and their exploitation conditions.

D3T4H2S address hydrogen storage with advanced materials and promising rsults for industrial development.

Nano solar cells aims to increase solar cells performances with nanostructured material layers deposition and QDSOC to develop high performance solar cells using quantum dots. Both projects are basic research at low TRL.

- HyAfrica (Call 2022)
- D3T4H2S (call 2023)
- NanoSolarCell (call 2022)
- QDSOC (call 2022)

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HyAfrica

HyAfrica: Towards a next generation renewable energy source – a natural hydrogen solution for power supply in Africa

Project coordinator: CONVERGE, Lda, Portugal
Partners:

- University Mohammed Premier (UMP), Morocco
- University of Pretoria (UP), South Africa
- Eduardo Mondlane University (UEM), Mozambique
- University of Lomé (UL), Togo
- Leibniz Institute for Applied Geophysics (LIAG) Germany
- Fraunhofer Institute for Energy Economics and Energy System Technology (IEE), Germany
- University of Limpopo (ULIMP), South Africa
- National Directorate of Geology and Mines (DNGM), Mozambique

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

HyAfrica is a well-executed and scientifically strong project that has made a significant contribution to the emerging field of natural hydrogen exploration. Through a combination of field measurements, geological analyses, modelling, and socio economic assessments, it successfully identified promising hydrogen occurrences in South Africa, Mozambique, and Togo, while maintaining scientific rigor and transparency throughout the project. Beyond its scientific achievements, the project delivered valuable tools, methodologies, policy recommendations, and exploration roadmaps, while also building substantial research capacity across African partner institutions. Despite some operational challenges, all key objectives and deliverables were achieved, leaving a strong foundation for future natural hydrogen research and development in Africa.

2) *PROJECT OUTCOMES & IMPACT*

HyAfrica has delivered significant scientific, societal, and economic value, helping position Africa within the emerging natural hydrogen sector. The project advanced scientific knowledge, developed innovative tools and policy recommendations, and laid the groundwork for future sustainable energy solutions. Its strong dissemination, capacity-building efforts, and focus on inclusive and socially responsible development have created a solid foundation for future research, investment, and impact across Africa.

3) *PLANNING, COORDINATION, COLLABORATION*

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HyAfrica was effectively managed through strong coordination, clear governance, and close collaboration between European and African partners. Despite some early funding-related challenges, the consortium adapted well and successfully delivered its objectives. The project's international partnership combined complementary expertise, fostered knowledge exchange and capacity building, and established lasting collaborations that will support future natural hydrogen research and development in Africa.

4) OVERALL COMMENTS

HyAfrica is a well-executed project that has made an important contribution to the emerging field of natural hydrogen exploration. Its multidisciplinary approach, significant hydrogen discoveries in several African regions, strong capacity-building activities, and commitment to open science are major strengths. The project also demonstrated scientific rigor by transparently reporting uncertainties and challenges, including cases where expected results could not be confirmed. Some limitations remain. The economic potential of the identified resources still depends on future drilling and validation activities beyond the project's scope. Data limitations in certain regions, particularly Togo, constrained the depth of analysis, and gender and inclusion aspects could have been integrated more systematically. Nevertheless, these challenges do not detract from the project's overall success and its valuable scientific, technical, and societal contributions.

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D3T4H2S

D3T4H2S: A data driven digital twin for improved hydrogen storage vessels towards challenges for energy transition

Coordinator: S VERTICAL (France).

Partners:

- Université Internationale de Rabat (Morocco)
- University of South Africa, College of Science, Engineering and Technology
- School of Engineering (South Africa)
- University of Hassan II Casablanca (UH2C) (Morocco)
- Université Dunărea de Jos (UGAL) (Romania)
- ENSTA Bretagne (France).

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project combines advanced experimental characterization, multi-scale numerical modelling, and data-driven machine learning, which can be considered the forefront of materials science and engineering research, especially for complex systems like hydrogen storage vessels. It is good that experimental results are used to calibrate and validate numerical models, ensuring that simulations reflect real-world behavior.

The use of machine learning models, trained in both experimental and simulation data, allows for predictive maintenance and real-time optimization. The project further includes comprehensive mechanical and thermal testing across a wide temperature range, including cryogenic conditions as well as advanced imaging.

There are dedicated work packages to address hydrogen permeability, which is the core of the research, using both experimental and computational methods, ensuring a thorough understanding of critical failure modes. The Work Packages are very clear and logically sequenced. The consortium was comprised of both academic and industry expertise from Africa and Europe in materials science, mechanical engineering, chemical engineering, artificial intelligence, and industrial design, ensuring all aspects of the methodology are covered by experienced researchers.

The project results can be adjudged to be both reliable and valid based on the rigorous experimental protocols, validated models, and peer-reviewed dissemination. Several results

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have been published or are under review in high-impact, peer-reviewed journals, indicating external validation by the scientific community.

The project has contributed substantial new knowledge and technical innovations to the field of hydrogen storage, particularly in the development of recyclable, high-performance composite liners and the integration of digital twin and machine learning technologies. These advances are likely to have a lasting impact on both scientific research and industrial practice in renewable energy storage.

The project has collaborated with industrial partners ensuring that the research addressed practical constraints and performance expectations, enhancing the real-world validity of the results.

The project was executed within the estimated timelines, and all major milestones were achieved.

The main results of the project at the final term are:

- successfully developed polyamide 12 liners reinforced with functionalized carbon nanotubes (CNT) with experimental validation
- designed and built a new, patent-pending experimental system for measuring hydrogen permeability in polymer membranes
- developed a multiscale model to predict hydrogen diffusion and permeation through CNT-reinforced liners, bridging microstructural features with macroscopic transport properties.
- achieved advanced numerical modelling and developed machine learning models for hydrogen tank design for safety and reliability resulting in a Hybrid Digital Twin Framework.
- Other results include development of literature and dissemination via workshops, conferences and peer reviewed publications.

2) PROJECT OUTCOMES & IMPACT

The project has delivered significant scientific impact by advancing the development of recyclable, high-performance thermoplastic composite liners for hydrogen storage, validated through both experimental and modelling approaches, and by pioneering a hybrid digital twin framework that integrates machine learning for design optimization. These innovations have strong potential economic, social, and cultural impacts, including enabling safer and more efficient hydrogen storage for mobility, industry, and domestic energy systems, supporting climate mitigation, and fostering local expertise and job creation in both Africa and Europe.

The consortium has already produced numerous peer-reviewed publications, conference presentations, and workshops, ensuring broad dissemination of results within the scientific community and to industry stakeholders.

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The project's results are highly innovative, with patent applications foreseen for the hydrogen permeability testing system and material formulations, and the digital twin and optimization tools offering added value for industrial uptake and future research.

While the report, unfortunately does not explicitly detail gender equality outcomes, the project's international and interdisciplinary collaboration has contributed to capacity building and inclusive knowledge co-development, supporting broader societal development goals. The project does not mention anything about gender in its design, but the final report insinuates to long-term benefits to society through wide-scale deployments of green hydrogen as part of its impact.

3) PLANNING, COORDINATION, COLLABORATION

Throughout its lifecycle, the D3T4H2S project demonstrated highly effective planning and organization, maintaining strong alignment with its objectives and methodology despite initial funding delays affecting a few partners. Tasks and responsibilities were well-coordinated among team members and partners in Europe (S VERTICAL, ENSTA Bretagne and University of Galati) and Africa (University of South Africa, International University of Rabat, University of Hassan II Casablanca) through structured project management, regular consortium meetings, targeted working sessions, and a shared digital platform that ensured transparent communication and smooth deliverable exchange.

Overall coordination was led by the industry partner, S VERTICAL a private sector player from France. The added value generated through this international collaboration fostered genuine co-development of knowledge and tools between African and European partners, strengthened local research capacities, and enabled interdisciplinary and transdisciplinary advances that may not have been achievable within a single discipline or region.

Timelines and milestones were managed efficiently, with the consortium reporting to adapting internal planning and rescheduling tasks as needed to minimize the impact of delays. As a result, all major deliverables were either completed or in advanced stages of completion, and the project was finalized major tasks within 32 months.

The materials, testing systems, and digital tools developed through the project are now positioned for possible industrial uptake and continued research.

4) OVERALL COMMENTS

Overall, the D3T4H2S project demonstrates a strong level of scientific quality, supported by a sound methodology, rigorous research methods, and the effective integration of experimental, computational, and data-driven approaches. The clear project structure, well-defined deliverables, and management plan further strengthen its scientific credibility. The project has also achieved good dissemination of its results through peer-reviewed

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publications, conferences, workshops, and engagement with industry and policy makers. In addition, the methodologies and tools developed have potential for transfer to other renewable energy applications, contributing to broader innovation in the sector. However, gender considerations and the potential societal benefits of the project are insufficiently addressed or explicitly documented.

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NANOSOLARCELL

NANOSOLARCELL: Integration of photonic conversion layers based on photoemissive nanostructured materials for improving sunlight harvesting ability of solar cells

Project coordinator: CNRS-CEMHTI, France
Partners:

- UDES, Algeria
- MU-EG, Egypt
- UCA-IMED, Morocco
- TUIAȘI, Romania

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project follows a scientifically sound and coherent methodology, moving logically from carbon dot (CD) synthesis (via flash calcination, microwave-assisted and hydrothermal routes, and electrochemical exfoliation, with metallic cation modulation) through characterization, polymer immobilization, and testing on Si-based and DSSC solar cells under indoor/outdoor conditions. The methods used (TEM, optical spectroscopy, quantum yield measurements, transmittance testing, and comparative electrical testing) are appropriate and appear rigorously applied, supported by an outdoor test bench at UDES/EPST CDER and aging studies of up to 7 weeks. Results are reliable and valid — quantitative, comparative, and consistent across cell types, with 2 published papers and 2 patents filed, though long-term durability and full economic analysis remain ongoing on partners' own funding. The project contributes new knowledge, notably combining carbon nanostructures with polymer composites on commercial-scale electrodes tested under real African outdoor conditions, and the finding that D2O as a dispersion medium markedly boosts CD photoluminescence and quantum yield. Progress matched the initial plan, with one approved time extension for outdoor/long-term testing (Task 3.2), indicating well-monitored milestones. Final-term results include a hybrid solar cell prototype, efficiency gains of up to ~5% on Si-based cells (meeting the ≥3% target) and 15–20% on DSSC devices, improved DSSC stability, 2 patents, 7 publications, an operative outdoor test platform at UDES, and training of 6 young researchers — though the ≥10% lifetime and ≥5% cost-reduction targets are only preliminarily supported. Capacity building was strong, with 2 joint EU-AU PhD theses (CNRS-UDES and UCA-TUIASI), 4 master's students, partner internships/exchanges, and engagement of industrial partners (Apel Laser, Giem).

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2) *PROJECT OUTCOMES & IMPACT*

Potential economic impact stems from low-cost, widely available precursors (including biomass waste) and simple, energy-efficient processing compatible with existing manufacturing lines, already drawing SME interest (MEBDOU, Algeria; KUSA, Tunisia). Potential social/environmental benefits include improved renewable energy access in isolated regions, circular-economy use of biomass waste, and an unplanned anti-counterfeiting application. Dissemination has been substantial: 7 publications, 2 patents, over 20 conference participations, 3 workshops, 8 seminars, 3 press releases, 2 videos/social media items, and participation in an Innovation Fair, reaching an estimated >3000 scientific and >500 public/media contacts. Innovation lies in the patented, low-cost, sustainable conversion layer, its easy application without specialized personnel, and its compatibility with both Si-based and DSSC technologies, plus the valorized outdoor test bench/database at UDES. The report does not provide information on the project's contribution to gender-equal societal development.

3) *PLANNING, COORDINATION, COLLABORATION*

Project planning and organization were effective throughout, backed by a signed Consortium Agreement (June 2022), a Data Management Plan, a Risk Analysis and Contingency Plan, a shared document-exchange platform, and a project website; the approved time extension further reflects responsive organization. Tasks were well coordinated across the 5 partners through a clear work-package structure (WP1–WP4), regular partner meetings, and on-demand follow-up meetings, complemented by internships and exchanges between partners. Timelines and milestones were largely respected, with only one formally approved extension (Task 3.2); differences in partners' national start/end dates reflect funding-scheme variation rather than coordination gaps. The international EU-AU collaboration generated satisfying added value, illustrated by two joint PhD co-supervisions, use of African testing facilities under real harsh conditions, and new networking/follow-up collaborations with African institutions and SMEs.

4) *OVERALL COMMENTS*

NANOSOLARCELLS is a well-conceived and well-executed project that met its core scientific and technical objectives. Its main strengths are (i) a coherent, multi-step methodology carried through from material synthesis to real device testing; (ii) concrete, quantifiable performance gains on both Si-based and DSSC solar cells, meeting or exceeding the >=3% efficiency target; a strong valorization record for a project of this size (2 patents, 7 publications/proceedings, 23 conference contributions); (iii) genuine capacity building through 2 joint EU-AU PhD theses and several master's students; (iv) proactive risk management (e.g., the CD aggregation issue was identified and mitigated by adjusting the polymer matrix); and (v) transparent, well-organized coordination (Consortium Agreement, regular partner meetings, a duly requested

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and approved time extension). The main weaknesses/limitations are that, (i) at the end of the reporting period, the long-term durability studies (target: >=10% increased lifetime) and the complete economic/cost analysis (target: >=5% cost reduction) had not yet been fully completed and remain under investigation beyond the project's lifetime, on the partners' own funding; (ii) the stability gains obtained on DSSC devices are described as less optimistic than those obtained on the Si-based devices; and (iii) the report does not document the project's contribution to gender-equal societal development. Overall, the project delivered solid, validated scientific results and a promising, low-cost technology with good follow-up potential (new SME contacts, a new funded project ONESELF/LEAP-SE), while some of its longer-term targets require further work to be fully confirmed.

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QDSOC

QDSOC: Environmentally friendly colloidal quantum dots for high performance solar cells

Project coordinator : Université de Lorraine, France
Partners:

- University of Liege, Belgium
- Material Science, Energy and Nanoengineering Mohammed V University in Rabat, Faculty of Science, MANAPSE Lab. Morocco
- University of the Witwatersrand, South Africa

Evaluation :

1) *SCIENTIFIC AND TECHNICAL OBJECTIVES*

The project builds on a strong scientific foundation, combining established colloidal chemistry with photovoltaic device engineering and advanced characterization techniques to study materials across multiple scales. While the methods are robust and well aligned with the objectives, moving from testing individual photoelectrode components to assembling full solid-state devices proved more difficult than expected, highlighting a gap between component-level performance and complete device integration. At the materials level, the results are solid and represent clear progress beyond the state of the art, particularly the development of Mn-doped CIZSe/ZnS quantum dots with high photoluminescence efficiency and significantly improved charge transport compared to reference materials. The work also shows that microwave-synthesized quantum dots and lead free perovskite nanocrystals can function effectively as photoabsorbers, and that advanced TiO2 deposition methods produce higher-quality films. Most planned milestones in the early work packages were achieved; however, full device performance targets were not reached due to stability issues at the photoanode-electrolyte interface, which also delayed prototype development. Key outcomes include successful synthesis of multiple quantum dot and perovskite systems, improved TiO_2 film engineering, and partial device assemblies showing a clear increase in photocurrent compared to baseline materials. In addition, the project made a strong contribution to human capacity building through the training of PhD and MSc students, international collaborations, and participation in academic exchanges and training programs.

2) *PROJECT OUTCOMES & IMPACT*

The project produced strong scientific results, especially at the materials level, leading to several journal papers and conference contributions. However, because a fully working integrated device was not achieved, the immediate industrial or economic impact remains

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limited. Dissemination was active and well managed through multiple channels, including academic publications, online platforms, project pages, media coverage, and public outreach events. The main innovation comes from developing environmentally friendly methods for producing quantum dots and improving TiO_2 film deposition techniques, both of which have good potential for scalable and sustainable applications. Gender balance was considered in recruitment policies, but in practice the leadership team remained mostly male, meaning this aspect was addressed more at the policy level than fully reflected in the project structure.

3) PLANNING, COORDINATION, COLLABORATION

The project was generally well planned, with clear work packages, realistic early timelines, and a sensible distribution of tasks across partners. However, there was not enough time left in the later phase to fully address a key stability problem that appeared during device integration. Each partner contributed well in their area, with some focusing on quantum dot synthesis and others on device and TiO_2 development. The collaboration between groups worked overall, and student exchanges were particularly effective, although there were some coordination and reporting issues with one partner. Most early milestones were achieved on time, but several of the final targets were not completed within the project duration. Overall, the international collaboration was a major strength. The combination of different expertise across countries created results that would have been difficult to achieve individually, and it also helped build strong long-term research connections that are likely to continue in future projects.

4) OVERALL COMMENTS

The QDSOC project delivered solid scientific results and made real progress in developing safer, heavy-metal-free photovoltaic materials, while also establishing a strong international research collaboration. Its main limitation is that a fully working device was not achieved, meaning the key efficiency target could not be demonstrated in practice, which reduces its direct application potential. The main technical issue was the instability of quantum dots on porous TiO_2 when exposed to electrolyte. Although a potential solution (ZnS passivation) was identified, there was not enough time left to test it, even though this risk was somewhat anticipated in the broader literature.

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Conclusion

The evaluation of the 23 LEAP-RE Pillar 1 projects demonstrates the scientific and technological value of joint AU-EU partnership in research and innovation on renewable energy. Across the portfolio, projects generated new knowledge, developed tools and prototypes. They also strengthened research capacities and established partnerships that extend beyond individual funding periods.

LEAP-RE Pillar 1 has established a valuable scientific and collaborative foundation. Its longer-term contribution will depend on turning that foundation into validated technologies,. Future cooperation should build on demonstrated achievements, address unresolved evidence gaps and provide differentiated pathways from research to implementation.

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