Smart microgrids as a solution for agriculture farms electrification

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Start 01/04/2022 - End 31/03/2025

Extended 28/02/2026

Project coordinators:
Lotfi BAGHLI, Serge PIERFEDERICI
Université de Lorraine,
France

LEAP-RE

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

Pillar-1 project

MG-FARM

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

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Consortium

Project coordinators:

- Lotfi BAGHLI, Serge PIERFEDERICI, Université de Lorraine (**France**)

Project partners:

- Université de Tlemcen

  CDER-UDES (**Algeria**),

- IECORP SA, and Université de Lorraine (**France**),

- TUB-WIP (TU Berlin), TUB-EET (TU Berlin), and MicroEnergy International GmbH (**Germany**),

- Ecole Nationale des Sciences Appliquées d'Oujda, Green Energy Park, and International University of Rabat (**Morocco**)

Aim of the project

Develop smart microgrids based on Renewable Energy System (RES)

Support the sustainable development of energy, water and agriculture sectors

Load profile (pumping, irrigating, cooling), storage strategies, sustainable agricultural practices

Relevance vs MARs

Digitized RE Microgrid & Smart Storage Systems

Contribute to the development of a data-based research (MAR 1) and education framework for the integration of smart grids (MAR 4) in MENA region

Experimental results and enhanced local capacities

Enable connected farms to increase their productio
save water and energy (MAR 5)

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Scientific and technical objectives

- Design and install TRL6 Digitized Microgrids with Smart Storage Solutions on demonstration farms in Algeria and Morocco and equip them with remote data monitoring infrastructure
- Plug&Play concept of microgrids that can be connected or disconnected without intervention or changes to manual settings
- Enhance partner's skill around Digitized RE Microgrid and Smart Storage Systems
- 3 PhD in co-supervision $\Rightarrow$ 2 PhD + 1 PostDoc + 2 self-funded
- Monitor and test the water and energy consumption levels, and agricultural production on the demonstration farms

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Scientific and technical objectives

- Develop a comprehensive Data Collection and Analysis Framework (DCAF)
- Conduct a baseline study on the agricultural practices and the socio-economic environment of the participating farms
- Identify and examine best agricultural practices for climate mitigation and adaptation in the region using specified methods in the DCAF
- Conduct a thorough assessment of the agricultural activities and practices of the pilot farms, including their energy and water consumption and utilize the results to model optimized energy, water, and material flow within the farms
- Model the current and the optimized agricultural processes on the farms using quantitative computer models

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Scientific and technical objectives

- Research new business opportunities from the use of Digitized Microgrids with Smart Storage Solutions in Farms in North Africa and their impact on the socio-economic environment in rural areas
- Develop workable market models for the farm
- Use data from the MG farms and the baseline study, simulate the best agricultural practices and the business opportunities
- Analyze data and outcomes and discuss findings with the relevant public and private stakeholders through series of workshops
- Members of the agriculture community are involved to facilitate the dissemination and appropriation by users
- Train farmers and scientific staff on how to run the microgrid and new processes

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Results achieved

- Study existing business models with farms having partial or no RE equipment at RIMSAR, OUADIN, BLFARM (Morocco) and BELAIDOUNI (Algeria) farms
- Installation (TRL6) of Greenhouse, 13kW PV, geomembrane pool, water tanks and control room at UDES pilot farm (Algeria)

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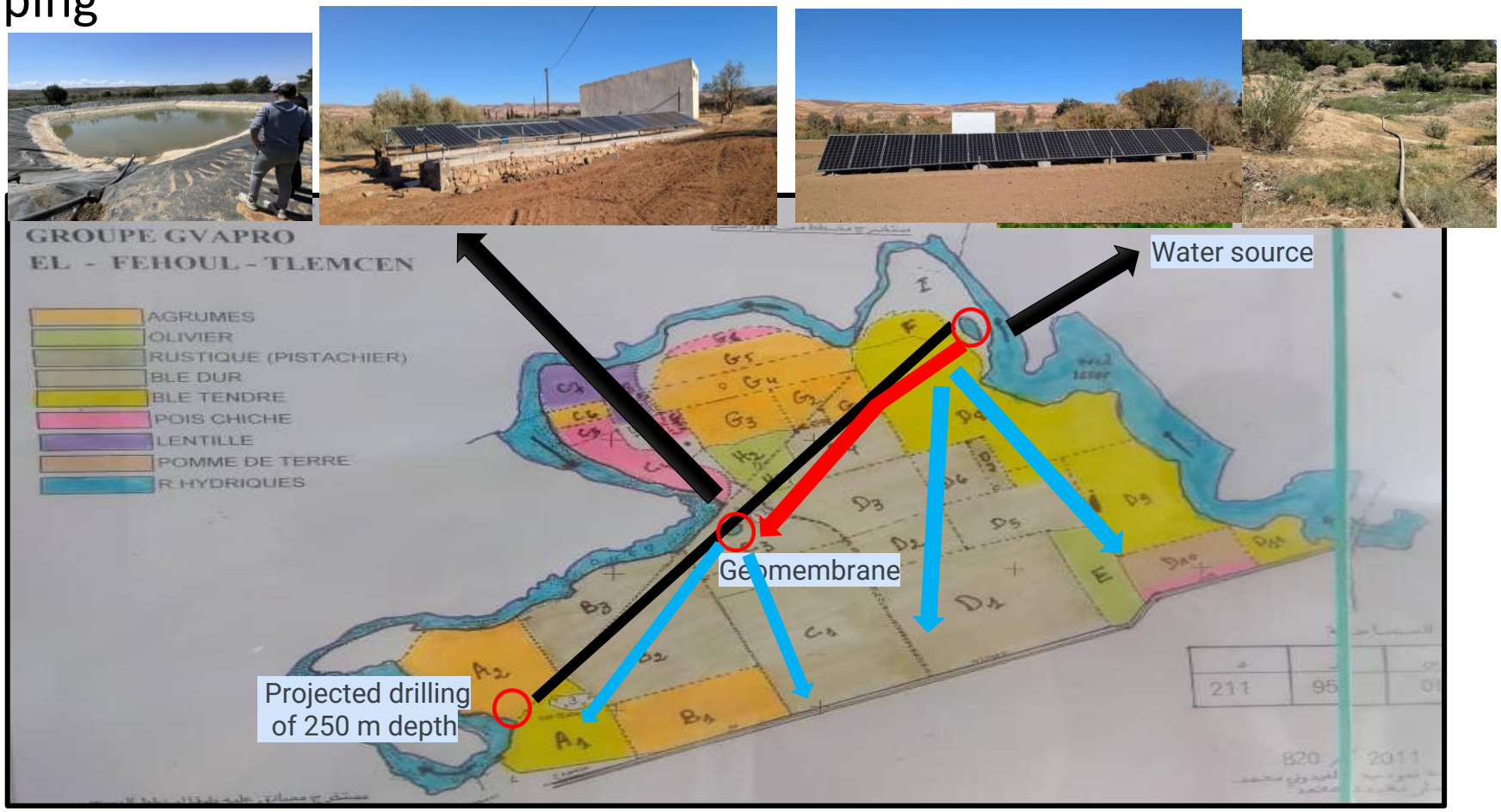
Results achieved

- BELAIDOUNI (Fehoul, Tlemcen, Algeria) farm: Study and install PV for pumping

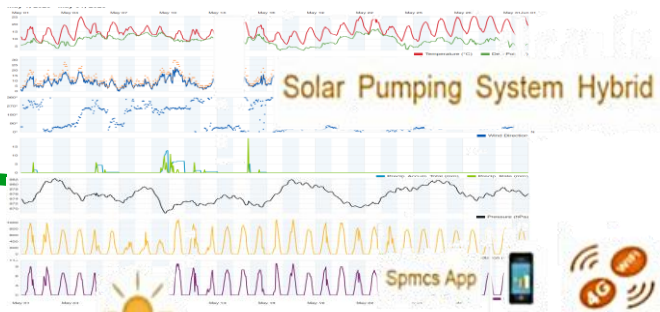


Weather station

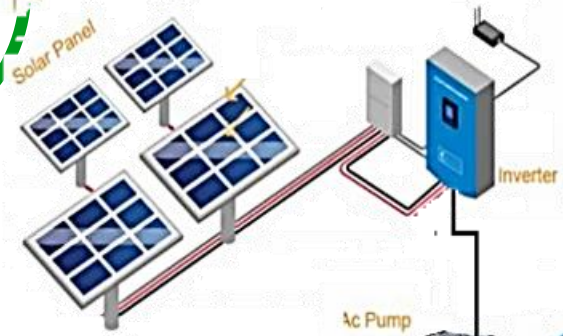
Results achieved

- BELAIDOUNI (Fehoul, Tlemcen, Algeria) farm
- TRL6 demonstrator

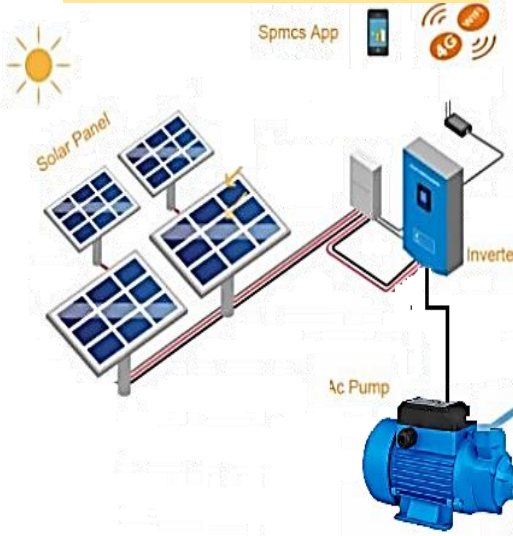
2 strings of 14 PV each (400W)
+
1 PV for lighting (security)

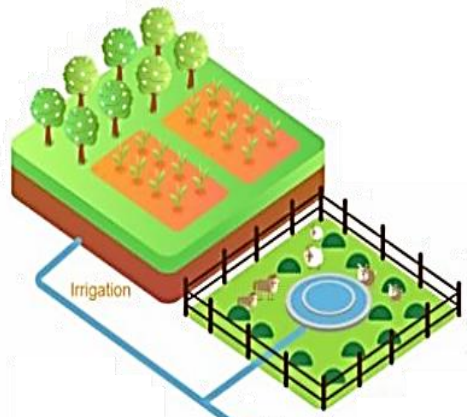


Irrigation



T valve
(1 to 2)





Water transfer to geomembrane (Water storage)

geomembrane basin

2 strings of 14 PV each (400W)
+
1 PV for lighting (security)

Water source

2 x 7.5 kW - 3 Ph - 230/400 V - 50 Hz
Q = 100/600 L/mn
Hmin = 33 m, Hmax = 56.5 m

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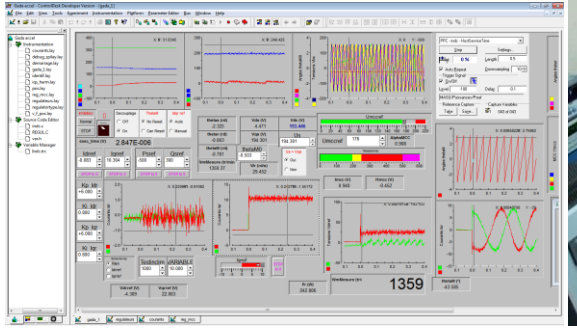
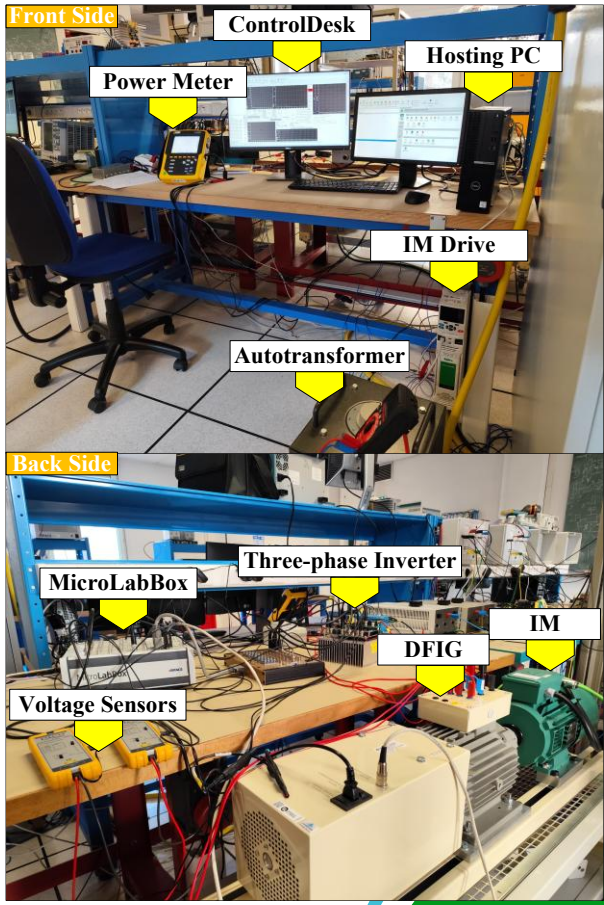
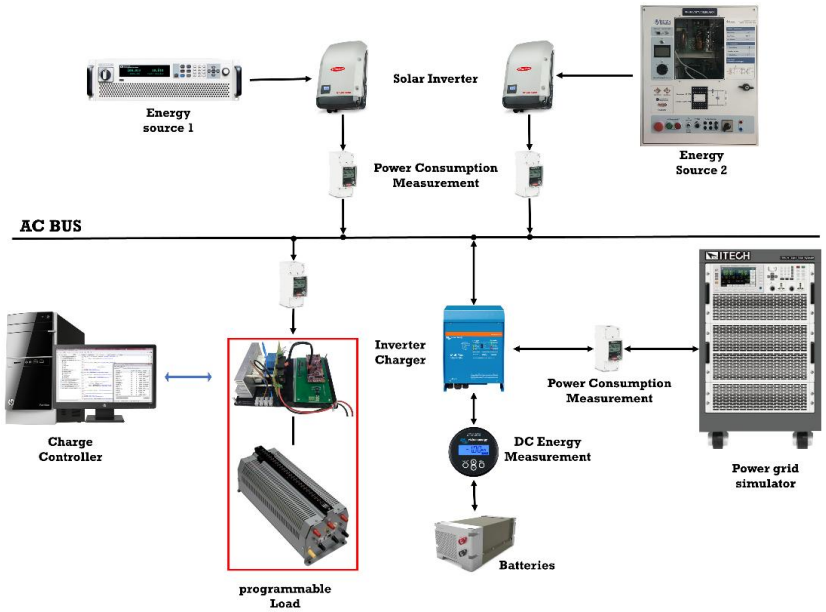
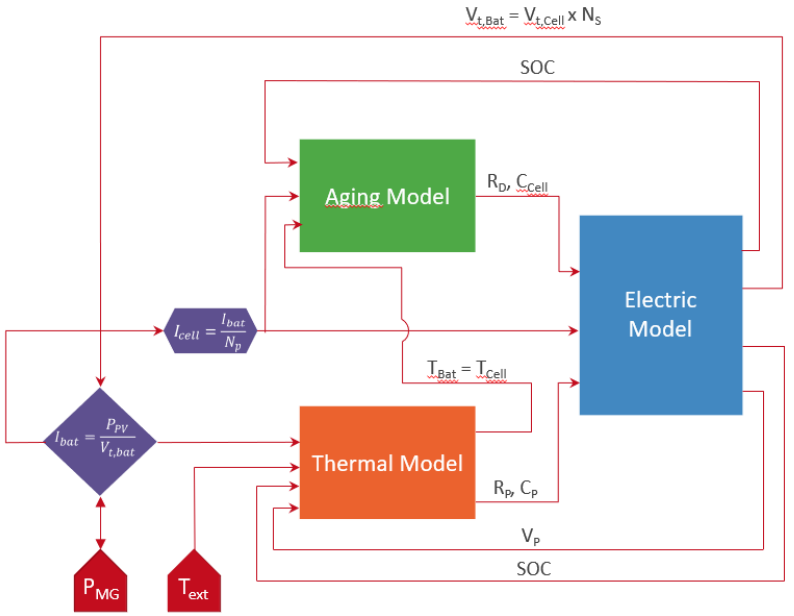


Results achieved

- Experimental benches at labs (TRL4) WTE at UoT (Algeria), UL (France) for PhD studies, batteries at TUB EET (Germany), Single-Phase Microgrid-AC Prototype at ENSAO (Morocco)
- Development of models and simulations: Li-Ion (LFP) batteries, Double Fed Induction Generator (DFIG)







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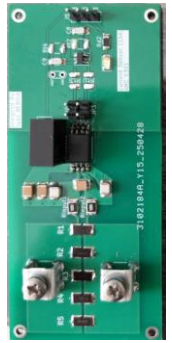
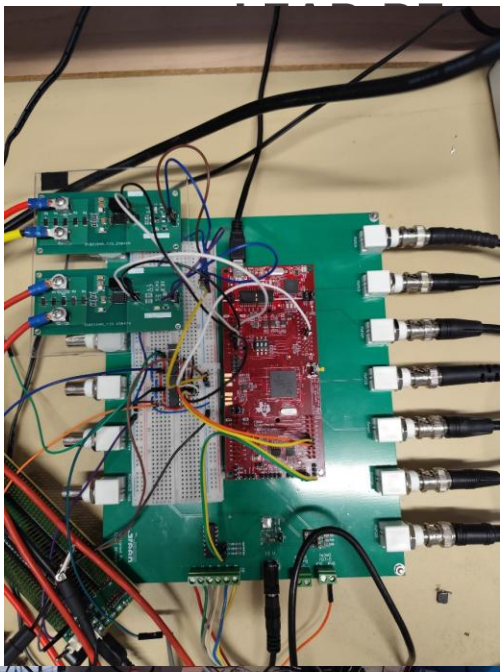
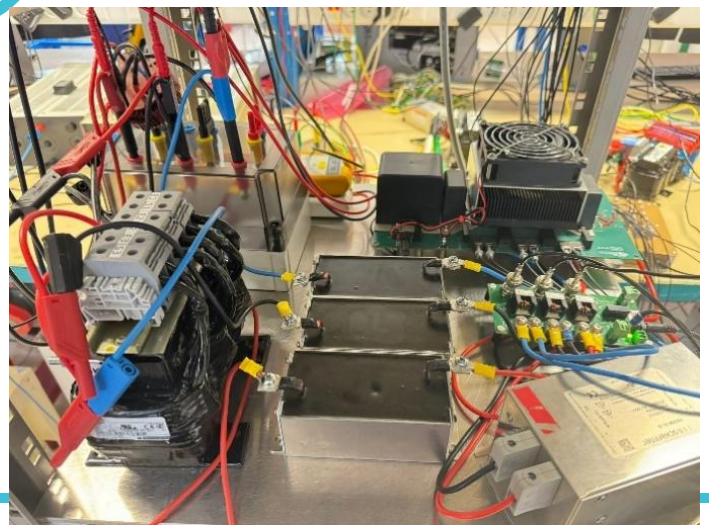
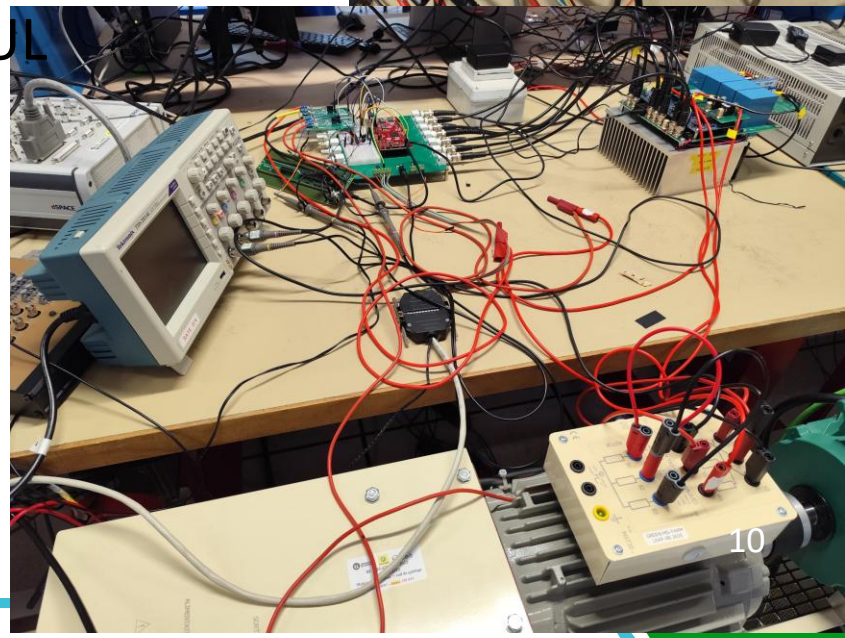
Results achieved

- Experimental benches at labs (TRL4) WTE at UoT (Algeria), UL-GREEN, UL-LEMTA (France) for PhD studies
- Low-cost DSC, DFIG on F28379D, UL-GREEN (2025)
- P-HIL and RCP on dSPACE MicroLabBox, UL-LEMTA (2023-2025)
- Experimental setup developed for the evaluation of energy management strategies in a cluster of AC microgrids at UL









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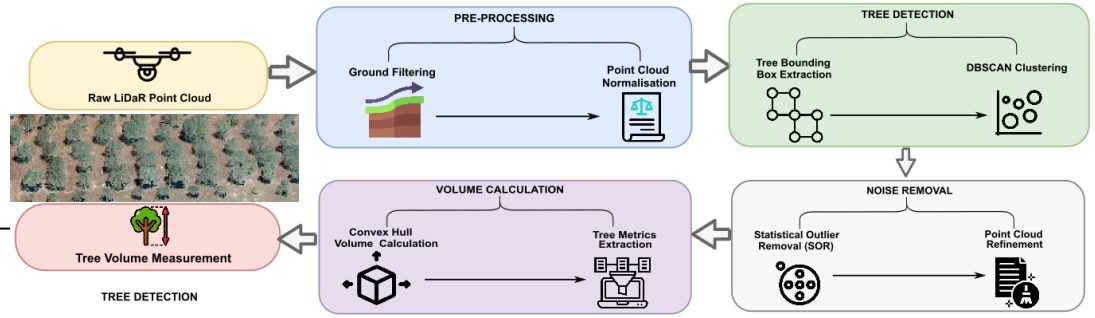
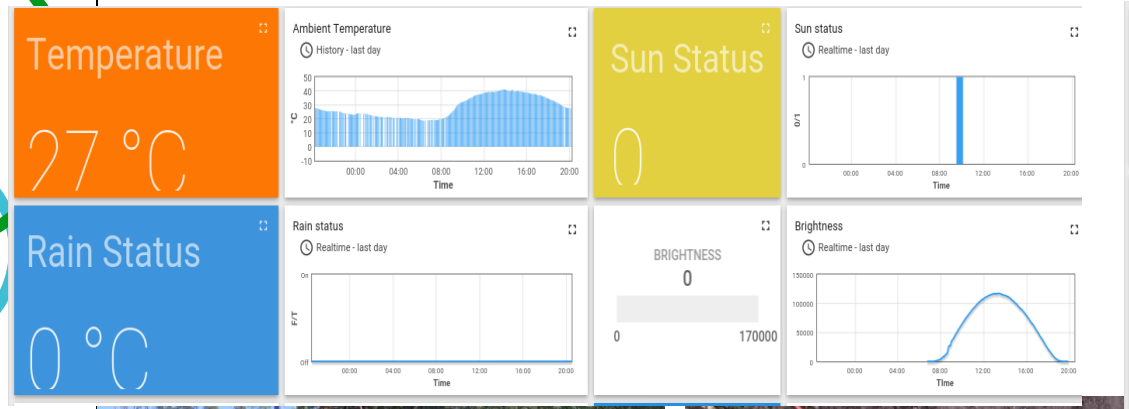
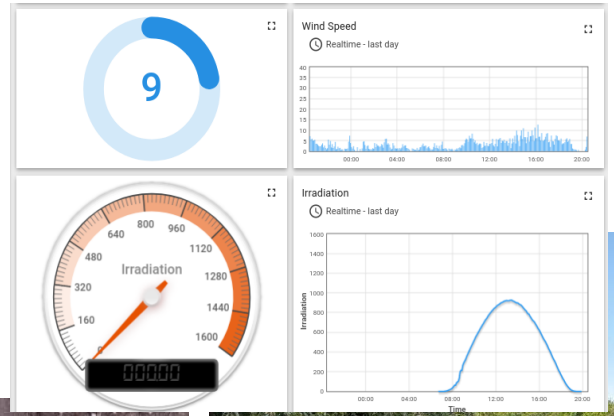


Results achieved

- Installation of Monitoring devices at pilot farm RIMSAR (Morocco)
- Estimation of olive tree volume (quadcopter and ML)





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Results achieved

- WP2: Analysis of the energy, water and agriculture policies and strategies
  - Sustainable Farming through Decentralized Energy Systems: Opportunities and Barriers
  - Energy policy in Morocco: Analysis of the national energy strategy's impact on sustainable energy supply and transformation
- WP6: Modelling the optimized energy, water, and material flow within the farm
  - Microgrid Applications and Business Models in Agriculture: A case study of Algerian farms
  - Macro Model for Microgrid connections in Morocco: Implications for Water-Energy-Food Nexus
  - Energy transformation in the MENA region: Sustainable pathways for Algeria and Morocco
  - Smart microgrids and agriculture in the global energy transformation discourse: a model for the Maghreb countries

Nb	STAKEHOLDER NAME	ABREVIATION	COUNTRY	SECTOR	Cooperation	Stakeholder Involvment	Institutional Classification	Level of Influence	Level of Interests
1	Dimel Solaire	**Dimel**	DZ	Energy	External	Secondary Stakeholder	Private sector	Low	High
2	ELUM Energy	**ELUM**	MO	Energy	External	Secondary Stakeholder	Private sector	Low	High
3	Energy Transo	**Energy Transo**	MO	Energy	External	Secondary Stakeholder	Private sector	Low	High
4	Water Technologies & Solutions	**SUEZ**	DZ	Water	External	Secondary Stakeholder	Private sector	Low	Low
5	Renewable Energy Semiconducteur Manufacturing	**Masen**	MO	Energy	External	Primary Stakeholder	Public sector	high	high
6	SIPSA-Filaha & Agrofood	**SIPSA**	DZ	Agriculture	External	Secondary Stakeholder	civil society	Low	High
7	Agriculture Intelligence & Technologies	**AITech**	DZ	Agriculture	External	Secondary Stakeholder	Private sector	Low	High
8	Algeria GAP Cert	**AGC**	DZ	Agriculture	External	Secondary Stakeholder	Private sector	Low	Low
9	The School of Agricultural and Life Sciences	**ENSA**	DZ	Agriculture	External	Primary Stakeholder	Academia	Low	Low
10	Renewable Energy Research Unit in Saharan Area	**URERMS**	DZ	Energy	External	Primary Stakeholder	Academia	High	High
11	International Center for Agriculture Research in the Dry Areas Biskra	**ICARDA**	DZ	Agriculture	External	Primary Stakeholder	Academia	High	High
12	Institut National de Vulgarisation Agricole	**INVA**	DZ	Agriculture	External	Primary Stakeholder	Academia	Low	High
13	Center for Reasearch in Applied Economics for Development	**CRAED**	DZ	Economy	External	Secondary Stakeholder	Academia	Low	High

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106	Agriculture in Morroco	**AgriMaroc**	MO	Agriculture	External	Secondary Stakeholder	Public Sector	High	High
107	Fellah Trade	**Fellah Trade**	MO	Agriculture	Internal	Secondary Stakeholder	Civil society	High	High
108	l'office national du conseil agricole	**ONCA**	MO	Agriculture	Internal	Primary Stakeholder	Public Sector	High	High
109	OCP - Al Moutmir	**AL Moutmir**	MO	Agriculture	Internal	Primary Stakeholder	Private sector	Low	High
110	Research Institute for Solar Energy and New Energies	**IRESEN**	MO	Energy	Internal	Key Stakeholder	Public sector	High	High

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Results achieved

- Participation to LEAP-RE Stakeholder forums:
  - Pretoria, 3-7 October 2022,
  - Kigali, 10-13 October 2023, Mid-term evaluation
  - Milan, 8-11 October 2024

- 1st Annual meeting at Marrakech with visits to pilot farms in Morocco and GEP facilities, 19-22 June 2023
- 2nd Annual meeting in Algeria and visiting facilities of Algerian partners UDES-CDER and UT (Bou-Ismail, Tlemcen), 10-13 June 2024
- 3rd Annual meeting in Tunisia and visiting facilities of future Tunisian partner ENIT-QehnA, 7-9 July 2025

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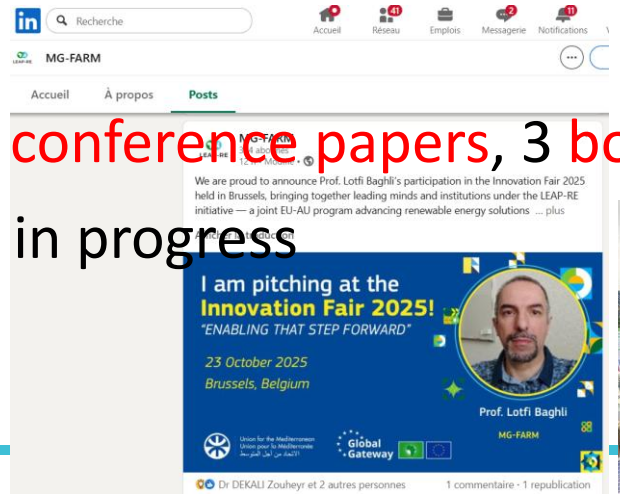
Communication

MG-FARM

- Websites :
  - https://mg-farm.microenergy-consulting.com/
  - https://www.leap-re.eu/mg-farm/
- LinkedIn (334 subscribers): https://www.linkedin.com/showcase/leap-re-mg-farm/
- Instagram: https://www.facebook.com/profile.php?id=61580428572162
- Facebook: https://www.facebook.com/profile.php?id=61580428572162
- YouTube: https://www.youtube.com/@MG-FARM.LEAP-RE

Publications

- 7 journal papers, 13 conference papers, 3 book chapters, 1 conference organized
- PhDs: 2 defended, 2 in progress



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End of project expected results (2026)

- Designing the prototypes, the microgrid, the battery, and the data interface
- Procurement and installation of equipment for storage and microgrid, including data monitoring equipment
- Optimization of existent installations with distributed energy between neighboring farms
- Training of data collectors, farmers and microgrid users
- Monitoring of water, energy consumption and agricultural production in the farms
- Communication and stakeholder engagement
- PhD thesis defense, publication in journal papers, participation in international conferences

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End of project expected results (2026)

- ***Become of the consortium set up on this project***

LEAP-SE with GH_2 Integration, including Tunisia, Continue PhD co-supervision (North-South)

- ***New collaborations initiated thanks to the results of the project***

PAUWES Pillar 2 LEAP-RE:

- Dialogue with policymakers and other stakeholders for research uptake
- Promoting digitalization and Entrepreneurship (Innovation Fair 2025) in Africa's Energy Sector

- ***New collaborations planned for the future***

Future collaboration regarding residential (villages): Extension of farm microgrids concept

- ***New funded projects and/or funding applications***

LEAP-RE 2023 SWITCH project,

LEAP-SE 2026 MG-FARM2 project (with GH_2), full proposal submitted

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

- Baseline study on the agricultural practices and the socio-economic environment of the participating farms. Data will be analyzed using appropriate simulation models for the purposes of extrapolation.
- Improvement of food and energy security
- Growth of agricultural exports
- Provide a new prosumer-type energy production and consumption model at the nexus of energy-water-agriculture and digitalization in rural areas
- Proposition of new electrification schemes in rural areas

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

- Capacity building: Training of data collectors, farmers and microgrid users
- Research cooperation between France, Germany, Algeria and Morocco: Common work, PhDs co-supervision, development of prototypes and test benches
- Building new relationship and research partnership between AU and EU labs and universities

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

- Data Collection, analysis, modelling
- Prototyping, on site experimenting and testing
- Digitized renewable energy Microgrid & Smart Storage Systems
- MAR1, MAR4, MAR5

THANK YOU

CONTACT US FOR MORE INFORMATION

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