MIDINA

Coordinated by Azeddine HOUARI
Nantes Université (FRANCE)

(07/2023– 06/2025)
12 months (03/2026)

LEAP-RE

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

Pillar-1 project

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

04 countries: France, Algeria, Romania and Morocco

Nantes Université

1985
جامعة محمد بوضياف - المسيلة
Université Mohamed Boudiaf - M'sila

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA ROMANIA

Université Sidi Mohamed Ben Abdellah

جامعة محمد الخامس بالرباط
Université Mohamed V de Rabat

- Group of **35 researchers**
- **Multidisciplinary partners**: Technical and Socio-economic aspects.

Aim of the project

Conduct a comprehensive study including technical, economic, and social aspects to evaluate how MGs can address **resiliency issues and to foster the RE-resources deployment in North Africa**.

Relevance vs MARs

#3: Smart stand-alone systems

#4: Smart grid (different scales) for off grid application

- Sizing and control of a MG
- Assessing the scalability of MG solutions
- Long-term evaluation of the Socio-economic benefits

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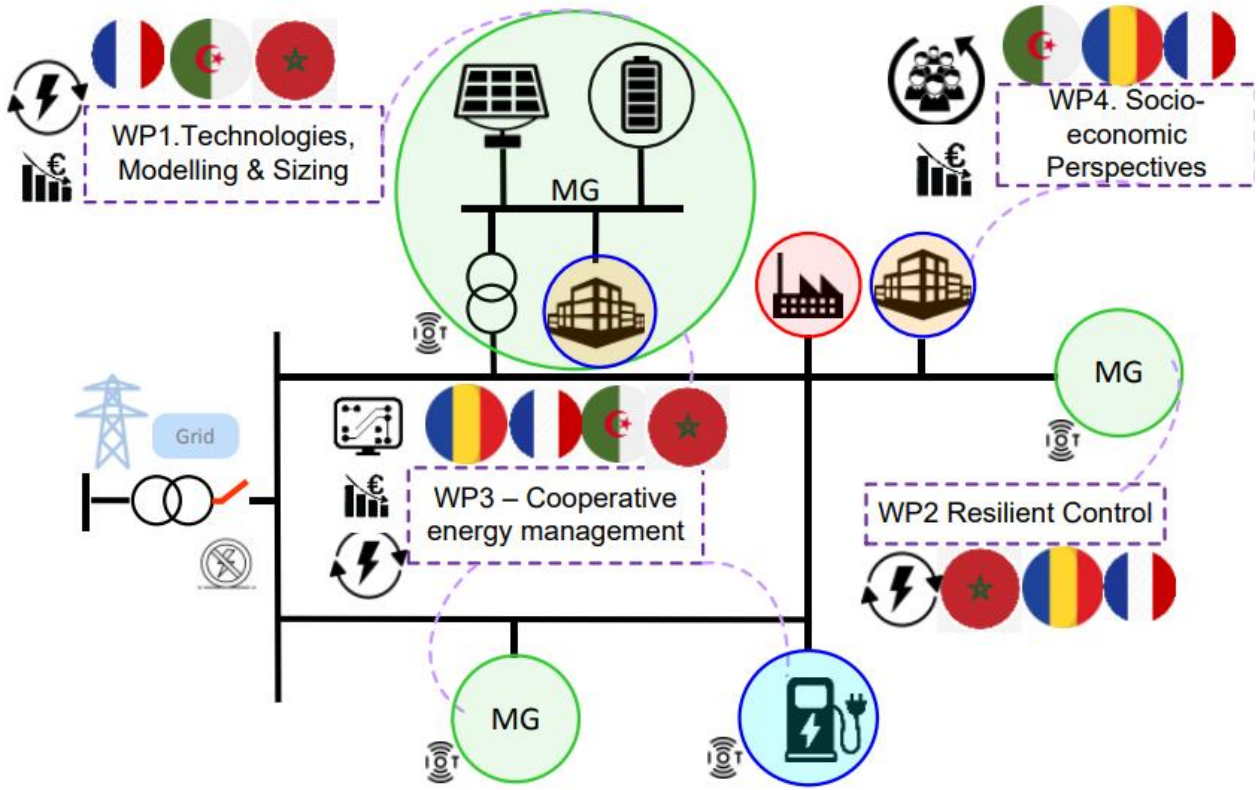
Key challenges addressed by the project

- **WP1-** Taking into account the stochastic specificities of **local weather** and **consumers' behaviour** ➔Propose **optimal sizing solutions**.
- **WP2-** Increasing the **power availability** in off-grid operation under **critical loading situations** ➔ Develop **advanced robust control**.
- **WP3-** Increase of **management issues** in a **cluster of MGs** ➔ Develop of **cooperative management** strategies.
- **WP4-** Impact of large deployment of MG technologies on **regional economic growth** ➔ Investigate **socio-economic prospective**



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➢ MiDiNA Meetings

Cluj-Napocca Tech University, Romania – 09/ 2025

M'Sila University, Algeria – 11/2024

CISTEM, Rabat, Morocco - 04/ 2024

Nantes University, France – 02/ 2025

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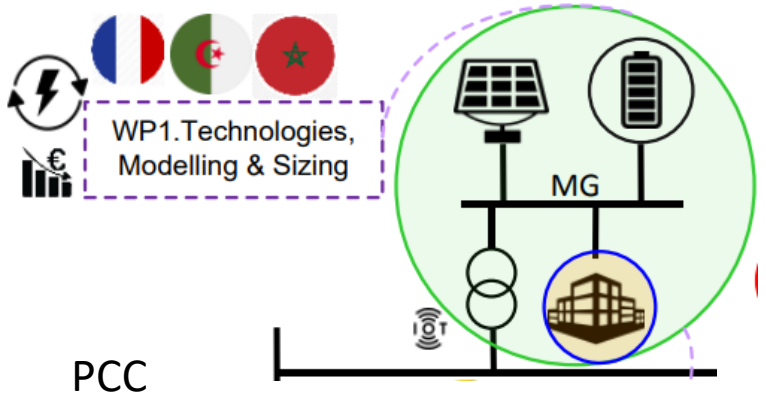
➢ *Results achieved*

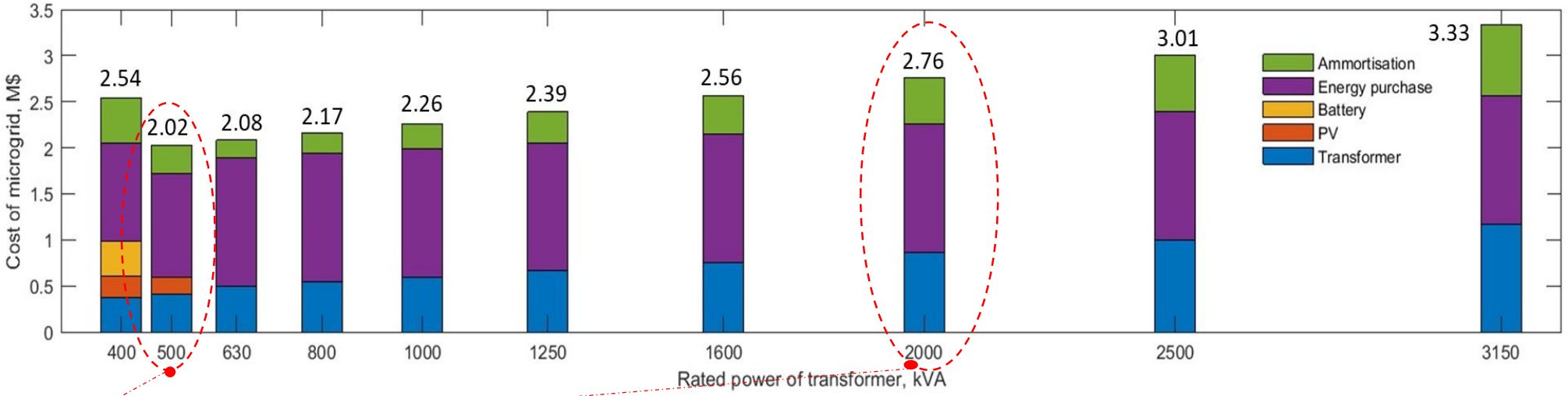
WP1- Sizing

- Minimization of microgrid's lifetime costs (**25 years**) - (Weather of M'sila city)

$$Obj = C_{transfo} + C_{BESS} + C_{PV} + C_{energy} + C_{amort} \rightarrow min$$



MILP optim



- **PV** + **BESS** + tolerating ΔT (19 to 24°) ➔ Transformer size can be devided by 04
- Optimal sizing for Microgrids (RE) is recommanded to propose economically viable solutions

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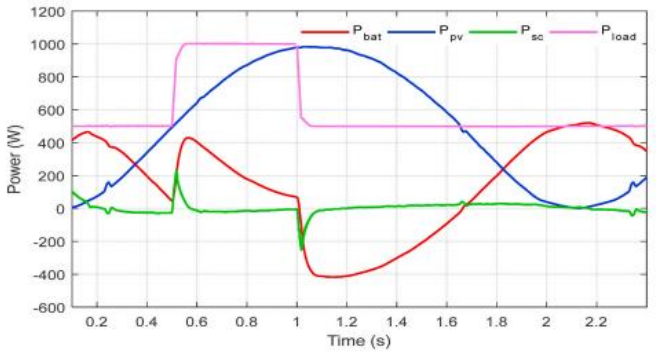
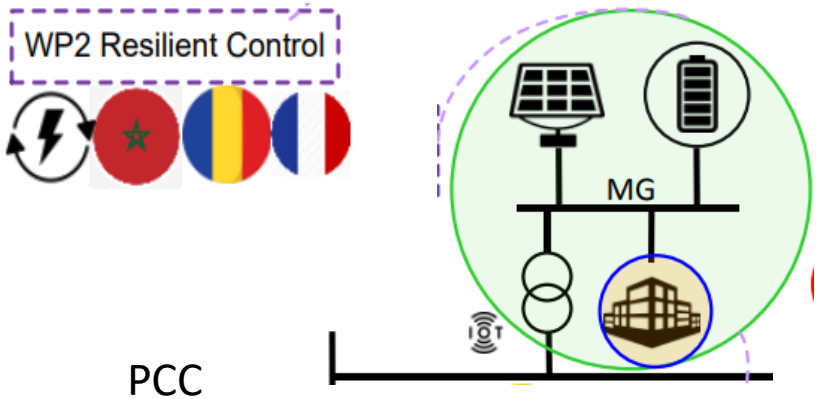
➢ *Results achieved*

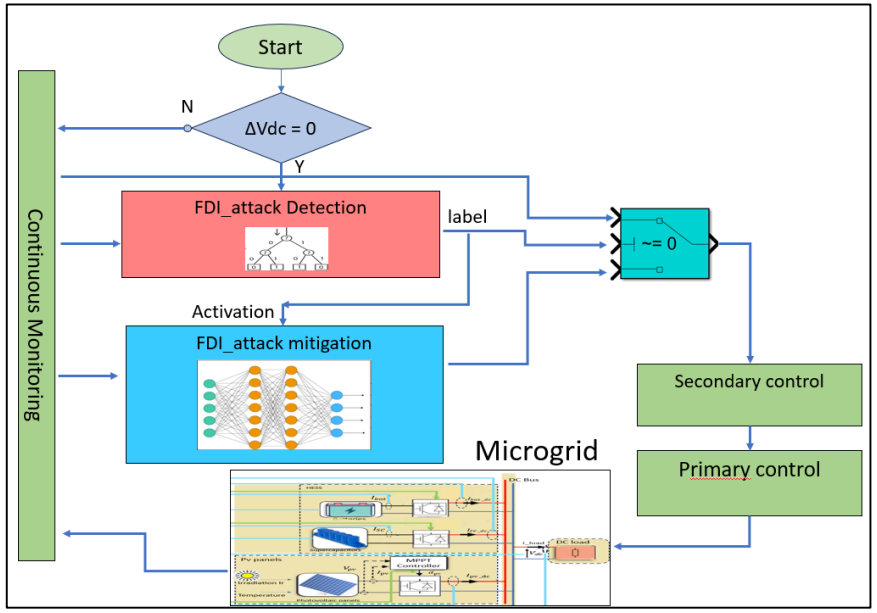
WP2- Resilient control

Optimal power sharing
« Sliding with optimisation »





Attack detection
« AI based detection algorithm **»**



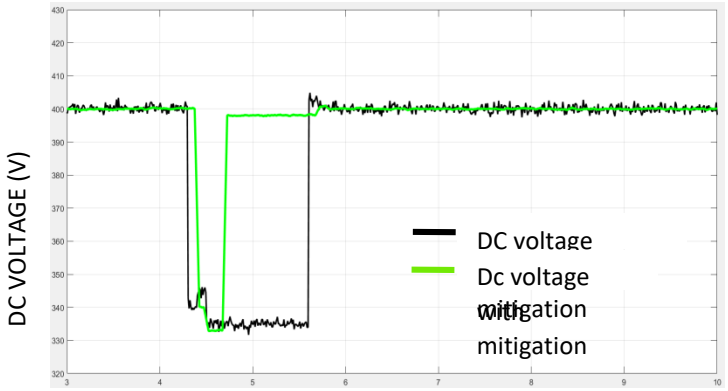


Figure 14: FDI Attack and Mitigation on load power profile effect on DC voltage

- Power quality enhancement
- Secure MG availability

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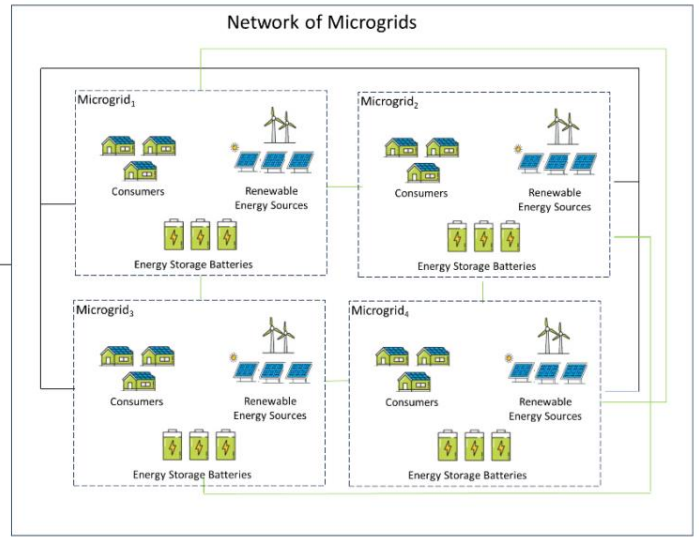
➢ *Results achieved*

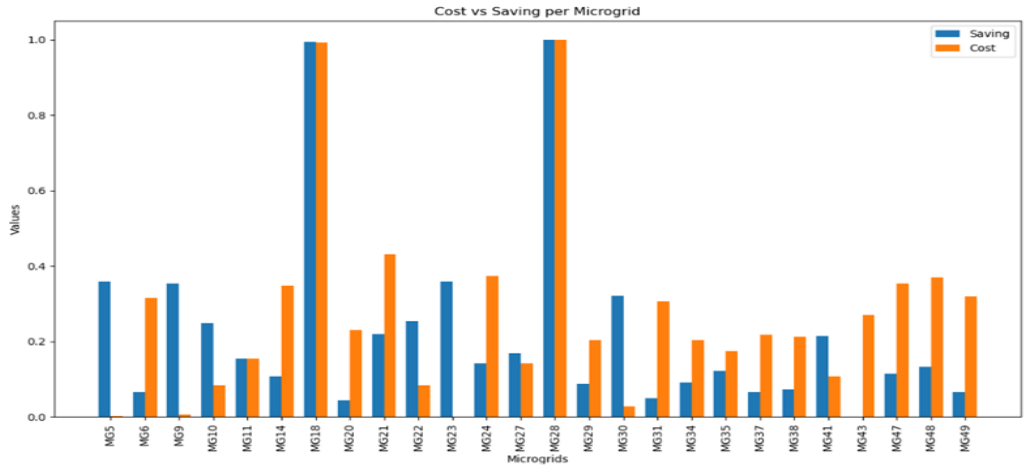
WP3-Cooperative management

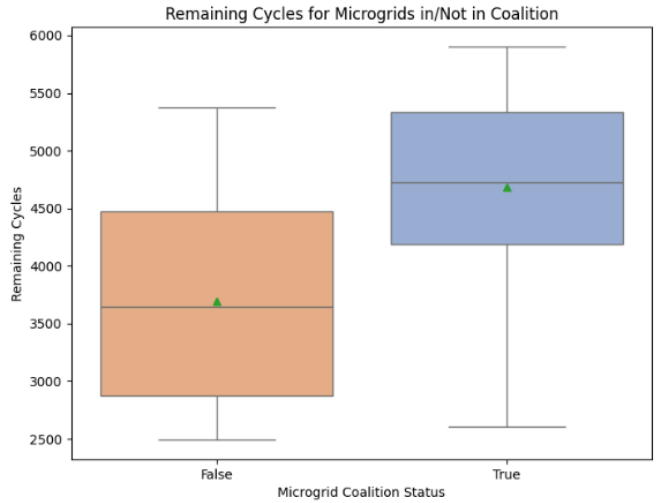
Collaboration between **100 microgrids** to create optimal coalitions for profitable energy trading in the energy market



"Hawks and Doves", Game theory algorithm

Cost vs Saving per microgrid in the optimal coalition in the case of energy surplus scenario





The **savings** achieved at the coaliton level can be **higher** than the costs associated with **trading** energy between the **coaliton** and the **energy market**.

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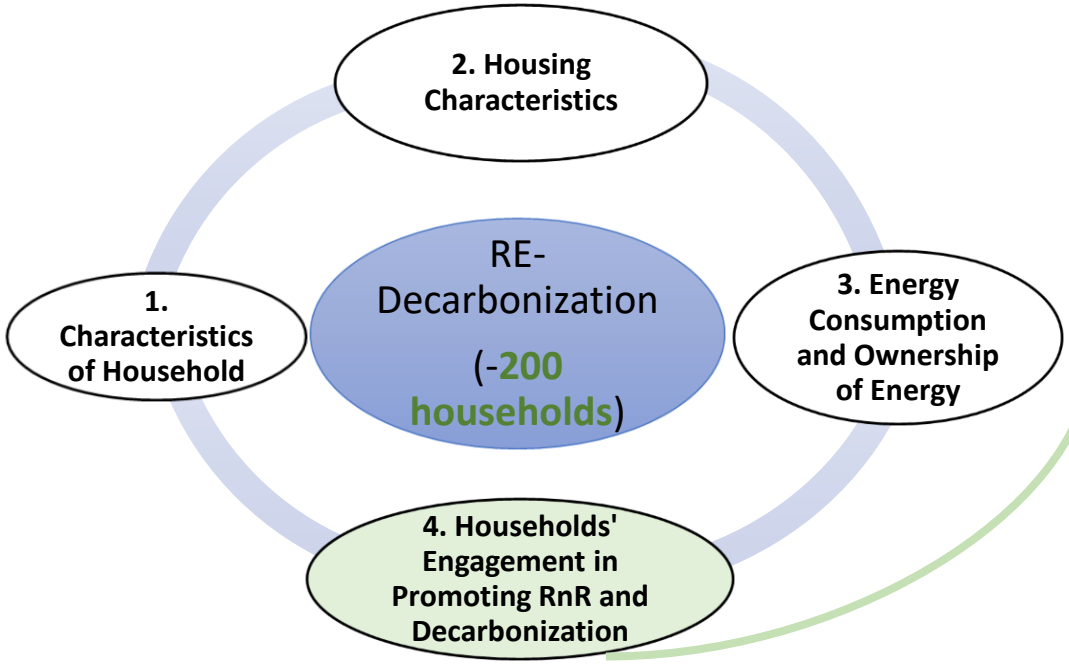
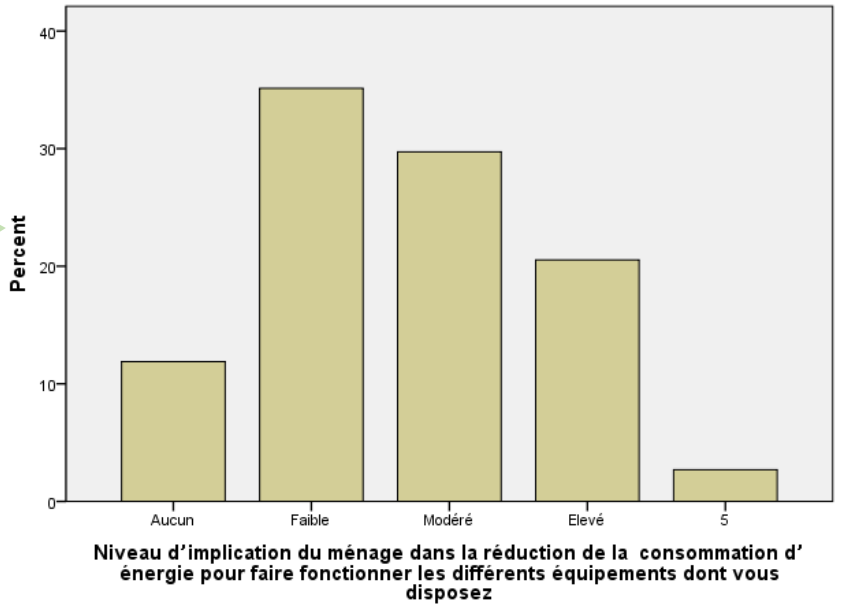
➢ *Results achieved*

WP4-Socio-economic perspectives

- 1 quantitative analysis of questionnaires regarding energy consumption in Algeria
  - **200 households**
  - Questionary of **73 questions**





- Good awareness of climate change and its impacts
- Implication in Consomption decrease is weak
- Public support is expected to promote households RE integration

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OPEN ACCESS

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➢ Scientific Outputs and Dessimination

➢ Review/survey papers : +04

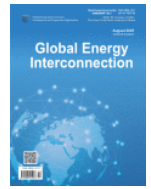
Abdul L, & al "**State-of-the-art of Microgrids Technologies: Operational strategies with manifold barriers and future trajectories**" *Renewable Energy Focus* 2025

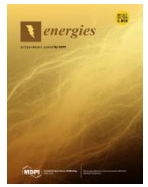
Ferahtia S, & al. "**Recent advances on energy management and control of DC Microgrid for cities and industry: A review**." *Applied Energy* 2024

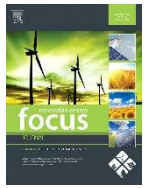
Naseri N, & al "**Resilient control for enhancing power availability in Microgrids in North African countries: A review**." *Applied Sciences 2024*

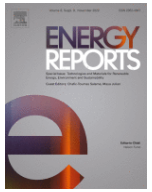
Hmad, J & al. "**A review on mode transition strategies between grid-connected and standalone operation of voltage source inverters-based microgrids**." *Energies* 2023

➢ Technical papers : +05









➢ Book Chapter : 02

Hachimi, M & al."**Cybersecurity Attacks and Defense Techniques in Microgrid: A Survey**." *Springer Nature* 2025

Hoummadi, MA al. "**AI and IoT for microgrid energy management**"

➢ Conferences : +12

ICPSE Turkey, CISTEM Rabat, SmartGridComm Oslo, SGE Toulouse, FES Cluj-Nappoca

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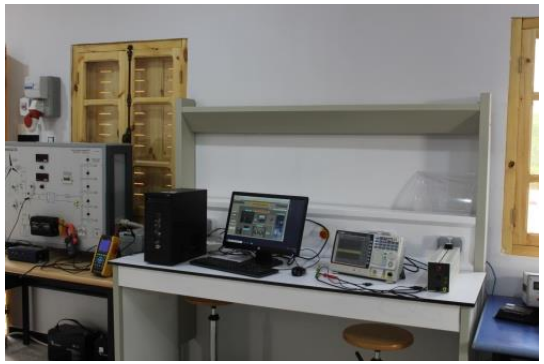
➢ *Results achieved*

Smart House Demonstrator – M'sila University

A Microgrid (10 kW)
Multi-source System (PV, Battery, Hydrogen, etc.)
Energy management to optimize consumption
Smart technology



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➢ *Workshops, Visits & Scientific Dissemination*

Ministerial Visit & MiDiNA Demonstrator Presentation
November 2024, M'sila University - Algeria

fête de la Science

Ludic Workshop : Exploring Microgrids and the Future of Energy Networks
03rd - 04th October 2025 Saint Nazaire

FUTURE ENERGY SOLUTIONS 2025

MIDINA Workshop : "Modelling and Real Time Simulation of Microgrid using Typhoon HIL
24th – 26th September 2025 Cluj-Nappoca

Typhoon HIL

Technical Workshop EU-AU PhD Student training : Hierarchical control of Microgrids, *14th October 2024 Saint Nazaire*

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➢ *Progress in compare with the state of the art*

- Comprhensive sizing method based on MILP optimisation with use of local data
- IA- based attack detection for microgrid resiliency
- Game teory for cooperative management of cluster of microgrids
- Representative Field survey on RE for decarbonisation in local city of Algeria

➢ *Increase in TRL (if relevant for the project)*

- Increase from 03 to 04 (laboratory test-benchs to smart-house demonstrator)

➢ *Possible evolutions of the objectives in progress of the project (explain), problems encountered during the project*

- Data acquisition difficulties : The process of collecting responses for the questionnaire has been to a certain extent difficult due to the complexity of the operation. Required local load data is not available from within the project partners.
- Mismatch between the progress of the project and the consortium agreement signatures especially in the first year of the project.

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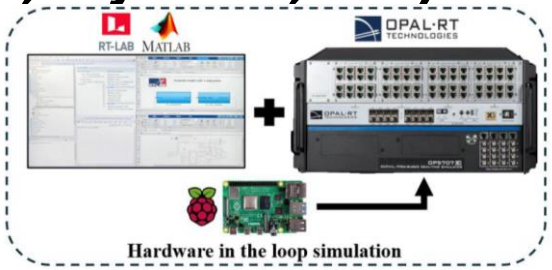
➢ *Specify whether the project has resulted in new products or developments (instruments, methods, software, etc.)*

Test benchs & Demonstrator

HIL emulators

Morocco & Romania



Smart-House demonstrator

Algeria

Methods, Optimisatrion tools and IA are shared between the WPs (WP1, 2 and 3) to propose inovative methods

- Comprhensive sizing method based on MILP optimisation
- IA-algorithm based attack detection
- Game teory for cooperative management of cluster of microgrids

➢ *Specify how id the project contribute to a gender equal societal development ?*

- Task 2- WP4 : Supporting development of RE and microgrids can support economic development ➔ reducing the time required for housekeeping and increase female educational attainment.
- Team of MiDiNA : Contribution to foster the career of young women researchers ➔ 11 Women In Research (WIR) among 35 membres / 01 Woman as Country Team Leader and 02 PhD students

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- ***Become of the consortium set up on this project***
  - LEAP-SE : 2026-2029 – “Smarter” - (TUCN Cluj-Napolca , Nantes Université, Université Sidi Mohamed ben Abdallah, Université de Tunis El-Manar) - (Qualified for the second round).
  - Launch of a professional master's degree in green hydrogen at the University of M'sila in 2024, in collaboration with the University of Nantes and the University of Lille.
- ***New collaborations initiated thanks to the results of the project (following publications, conference presentations, etc.)***
  - Collaboration with Hawassa University (Ethiopia)
  - Collaboration with Ouargla University & CDER (Algeria)
- ***New collaborations planned for the future (to answer what problem? Industrial or other perspectives?…)***
  - DUT Project- Driving Urban Transition to a sustainable future. Cooperative management of urban energy community, Partners : Estia School/ Nantes Université/ University of Tunis el Manar/ Universidad del País Vasco

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

1. Results support that microgrids integration as a key solution for enhancing energy security and regional equality through stand alone systems :

- Creation of local development opportunities (small companies)
- Contribution to reduce home labour and life quality therfore impact positively the gender equality especially in rural and remote areas like semi aride-regions.

2. Scalability and interconnexion of microgrids assisted by communication technologies is a candidate solution to devellop local energy communities :

- Strengthen ties between skateholders(Prosumers, industrials,…) by bringing them together around a collective project.
- Improving smart grids and power storage systems is essential for enhancing the efficiency and reliability of RE integration.
- Create new market opportunities

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

Develop of comprhensive and replicable methodologies for MGs ➔ fit with the AU-EU roadmap for research and innovation.

- Technichal solutions : sizing, control and mangement.
- Development of non-technological: socio-economic analysis and Field survey in Msila city

Capacity building - Exchange knowledge and trainings

- 04 PhD with works associated whith MiDiNA (Tesfay Mulialem, Ahmed Tejani, Nesrine Naceri, khadidja El hourari).
- Increase of commun scientific publications – boost young researchers careers.

Build of a pilot microgrid emulators/demonstrator

- Develop of 03 test benchs (TUCN, USMBA, UM5S) and smart-house demonstrator at M'sila ➔ Strenghth research and teaching capacities of the partners in microgrid topic.

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

- Develop of techno-economic sizing approachs for microgrids
- Resilient control and power management of microgrids
- Cluster of microgrids cooperation
- Socio-economic perspectives of RE deployment in Africa

THANK YOU

CONTACT US FOR MORE INFORMATION

www.leap-re.eu

contact@leap-re.eu

@leapRE_EU

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