

Newsletter

on the new developments in the project

Renewable Energy-based E-Mobility in Higher Education



Some of the participants of the REMO conference

REMO Conference in Morocco: How the introduction of e-mobility can succeed and contribute to climate protection

Philine Ginsberg, former Project coordinator (THI)

How electric mobility and renewable energies should be thought of and developed together was discussed with experts during the REMO Conference on 07 November 2022 at the Moroccan partner Al Akhawayn University (AUI) in Ifrane.

With over 100 participants from Morocco, Tunisia, and Germany, the hybrid conference titled "Electric Mobility and Related Renewable Infrastructure: An Outlook from the Stakeholders" offered a multifaceted platform for exchange on the topics surrounding the energy and mobility transition.

The relevance of the conference theme became clear in the opening speeches of AUI President Dr Amine Bensaid and Prof Wilfried Zörner, Head of the Institute of new Energy Systems (InES): "Not only technological feasibility is essential to master the mobility transition, but it also requires changing behavioral patterns in the population and awareness of the great responsibility of future generations," emphasized Dr Amine Bensaid.

IN THIS EDITION

REMO CONFERENCE IN MOROCCO - P.1

INDUSTRY WORKSHOP AT ENSTAB - P.3

REMO RESEARCH PUBLICATIONS AUI - P.5

REMO STUDENT OF THE MONTH - P.9

RESEARCH STAY OF AUI STUDENT AT THI - P.9

PERSONNEL CHANGE AT INES-THI AND THE REMO PROJECT - P.10

Prof Wilfried Zörner supported this approach by emphasizing the correlation between electric mobility and renewable energies, and the need to include both into degree programs to train local professionals with practical expertise in Morocco and Tunisia.

In the morning, the one-day event focused on the political framework and national goals, which were presented by Dr Rachid El Mrabet (Director of the public utilities development company of the province of Berkane Marafik, Morocco), Mr Ernst-Benedikt Riehle (Senior Associate, International Cooperation of the German think tank Agora Verkehrswende) and Mr Abdelhamid Gannouni (Deputy Head of Energy Efficiency in Transportation, National Agency for Energy Management, Tunisia).



Field trip to Green Energy park

During the morning presentations, it became clear that political regulations are essential to make progress in achieving mobility transition respectively renewable energy goals. Some examples, including a concept for the introduction of electric local transport in the Moroccan province of Berkane, showed the local efforts. This concept plans to introduce a public transport network with around 100 electric buses in the next few years.

Next to the interesting input of an established and successful automotive supplier, all participants got the chance to learn about the experiences of two Start-Ups from Morocco and Tunisia. They presented their challenges concerning the mobility transition: Dr Karl Reinhard Kolmsee, Head of Product Portfolio Management Energy Systems at the German automotive industry supplier Webasto SE, spoke in favor of interdisciplinary cooperation and reminded the audience that the German automotive industry especially must anticipate the transition to remain successful and an important pillar of the German industry. It became clear that young companies in particular are taking advantage of the current mood of change and are often able to enter the market more quickly with innovative solutions.



REMO Conference in Marocco



AUI President Dr Amine Bensaid (middle) and Prof Wilfried Zörner (left) opened the REMO conference together with Prof Ikbal Msadaa (second left) and Prof Khaled Grayaa (right).

One of these Start-Ups was iSmart from Morocco, the first Moroccan manufacturer of charging stations for electric vehicles. According to Dr Salima Sarikh of iSmart the demand for wall boxes is still very low. This is due to a lack of political framework conditions and incentive systems for the purchase of e-vehicles, as well as a deficient public infrastructure, which has so far prevented the widespread implementation of e-vehicles. Ms Khadija Jallouli, founder and CEO of HawKar from Tunisia, presented her product, an electric vehicle that addresses the needs of people with reduced mobility. According to Ms Jallouli, HawKar thus offers demand-oriented mobility service products for people with reduced mobility, who make up around ten percent of the total population in Africa and the Middle East alone.

The intensive exchange during the conference revealed numerous new options for action and cooperation and illustrated that the close collaboration between the different stakeholders from science, business, and politics is crucial to successfully shape the energy and mobility transition. The conference day ended with the official unveiling of the first charging station installed at the Moroccan partner university AUI.

The conference was part of the “Renewable Energy-based e-mobility in Higher Education” (REMO) project, which on the one hand aims to further develop study contents in the fields of renewable energies and e-mobility in order to train local professionals with practical expertise in Morocco and Tunisia. On the other hand, the participating universities Al Akhawayn University in Ifrane, the Tunisian University of Carthage - Ecole Nationale des Sciences et Technologies Avancées à Borj Cédria (ENSTAB), and InES at Technische Hochschule Ingolstadt, Germany, are working together with industrial partners on current research questions in the field of mobility transition and renewable energies.

Industry Workshop at LaRINA-ENSTAB

Dr Ines Mehouachi

In the framework of the REMO project, the Laboratory of Smart Grids and Nanotechnology (LaRINA) team from ENSTAB organized an industrial workshop in its second edition, entitled "Electric Mobility and Renewable Energies in Tunisia" on December 08, 2022. This event took place at the Sheraton Hotel, Tunis. The main objective was to discuss the regulatory, financial, and technical framework of the transition to electric mobility in Tunisia. The workshop brought together the stakeholders of electric mobility and renewable energies in Tunisia, including the industrial partners of LaRINA-ENSTAB laboratory such as the Tunisian company of electricity and gas (STEG), TotalEnergies, BYD, HawKar, and DeepVolt.



Group picture



Panel 1: the Moderator is Prof Ikbal Msadaa. The panelists are (left to right): Dr Mariem Trojette (LaRINA/ENSTAB), Ms Dhouha Gharrab (STEG), Mr Zied Chalghoumi (TotalEnergies), Mr Karem Chatti (DeepVolt).

The aim of this event was to bring together researchers and technical leaders from academia, industry, and government to discuss the transition to e-mobility and the integration of renewable energies in Tunisia. Prof Khaled Grayaa, country coordinator of the REMO project and Director of LaRINa-ENSTAB gave the opening speech of the workshop. Prof Ikbal Msadaa, the project's third sub-project coordinator, moderated the first panel in which the transition to e-mobility challenges and issues were discussed. The second panel, which dealt with the topic "Impact of e-mobility and renewable energies on the grid" was moderated by Prof Faten Kardous, coordinator of the project's second sub-project.

During the first session, Prof Khaled Grayaa presented an economic and ecological study of the use case of fleet electrification in the Nabeul region in Tunisia. The objective of this presentation was to encourage the industrials to apply the proposed application using real data with model refinement according to the settings of each company.

During the second session, Mr Lazher Mejdi presented the results of his research work related to the impacts of e-mobility and renewable energies on the electric grid.

Between the two sessions, Prof Khaled Grayaa and Ms Khadija Jallouli signed the partnership agreement between LaRINa-ENSTAB and HawKar in the framework of the REMO project. This partnership aims to accelerate the higher education transformation, strengthen the cooperation between industrial businesses and universities and boost the e-mobility through common projects.

During the two panel sessions, the problem of energy transition specifically transportation electrification was highlighted from a wider range of perspectives. The state of the art about e-mobility and renewable energies in Tunisia as well as the challenges of the sustainable energy transition were discussed from different aspects (techno-economic and regulatory framework) during the first panel. It was stated that there is a rapid need for change towards another form of energy and transition to the e-mobility in Tunisia, hence the importance of integrating renewable energies, especially for the transportation sector.



Prof Khaled Grayaa (right), Director of LaRINa-ENSTAB and Ms Khadija Jallouli (left), CEO of HawKar



Mr Lazher Mejdi, PhD student, LaRINa member



Panel 2: Prof Khaled Grayaa (1st on the left), Mr Radhouane Dakhli from STEG, Mr Jmaiel Soussi, from BYD.



Discussions during the second panel moderated by Prof Faten Kardous

For example, TotalEnergies has been investing in the deployment of charging infrastructures to encourage the promotion of EVs in Tunisia since 2020. A general opinion was that the transition to e-mobility in Tunisia is possible and the ecosystem is ready for it, but it needs the government's support for this transition, especially in regards to the regulatory framework. Discussions were very fruitful and enabled a great exchange of ideas where stakeholders from industry and academia presented interesting case studies and personal experiences related to the topic of e-mobility and renewable energies in Tunisia.

The main discussed subjects are summarized as follows:

- The non-intrusive technique (used as a measure to prevent unauthorized intrusion, which could be engendered by smart metering)
- Evaluation of different investment scenarios related to EV transition such as time, cost, and accuracy of generic data analytics and simulation tools
- Question of strengthening the network
- Penetration rate of renewable energy
- Commercial / Business issues
- Net Metering / Smart Metering in Tunisia
- Digitization
- V2G and G2V approach.



REMO team from LaRINa-ENSTAB

If you are interested to receive further information on the results of the workshop, please do not hesitate to contact Prof Khaled Grayaa (see contact details on the last page).

REMO Research publications – AUI

Hamza El Hafdaoui

This year, the AUI team, coordinated by Prof Khallaayoun and led by Mr HamzaEl Hafdaoui, published three journal articles in collaboration with THI/InES:

Publication# I: Impact of Hot Arid Climate on Optimal Placement of Electric Vehicle Charging Stations (<https://doi.org/10.3390/en16020753>)

Authors: Hamza El Hafdaoui, Hamza El Alaoui, Salma Mahidat, Zakaria El Harmouzi, and Ahmed Khallaayoun

In a world increasingly focused on reducing fossil fuel use and transportation-related pollution, electric vehicles (EVs) have gained popularity. However, the rapid growth of EVs has revealed major challenges, including a lack of charging stations, uneven distribution, and high costs.

This study aims to address these issues by enabling EV drivers to locate charging stations conveniently while considering economic, practical, geographical, and atmospheric factors. Focusing on the Fez-Meknes region in Morocco, the research utilizes a MATLAB/Simulink model to analyze battery autonomy, incorporating weather, driving style, infrastructure, and traffic (as in Figure I-1) The study also employs collected data and simulations to visualize the impact of ambient temperature on EV charging station placement. By developing a genetic algorithm-based model, the research optimizes charging station locations based on factors such as cost, road width, power availability, and autonomy range. The findings are presented using node-link networks (Figure I-2) and interactive GIS maps (Figure I-3 and Figure I-4), offering readers a visual understanding of the relationship between ambient temperature and EV charging station optimization.

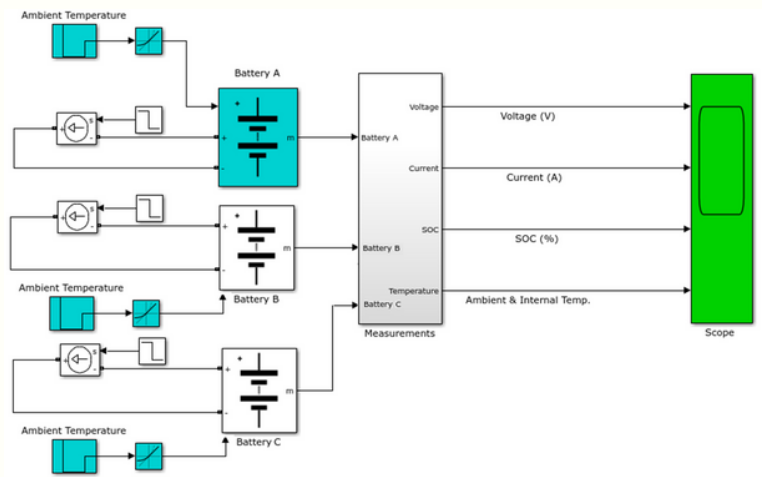


Figure I-1: Electric Vehicle Battery Model in Simulink/MATLAB

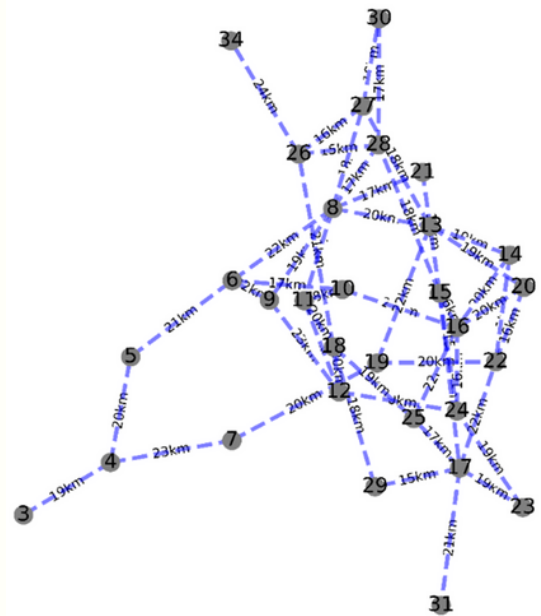


Figure I-2: Node-Link Network

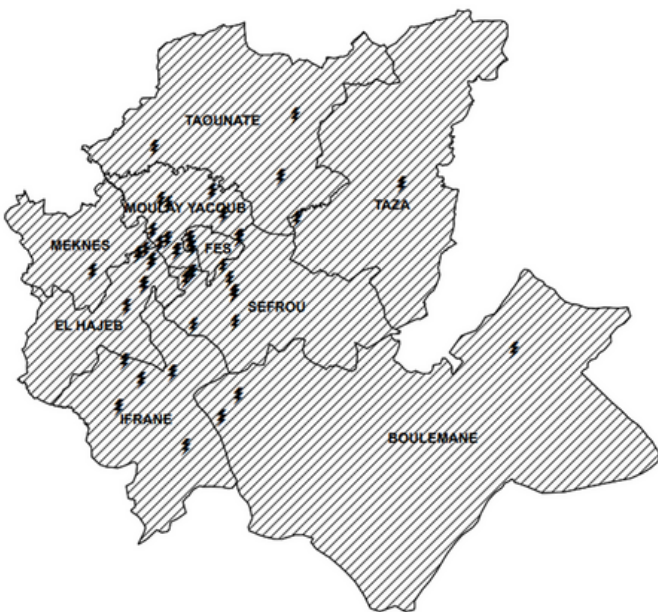


Figure I-3: Leaflet Map for Potential EVCS

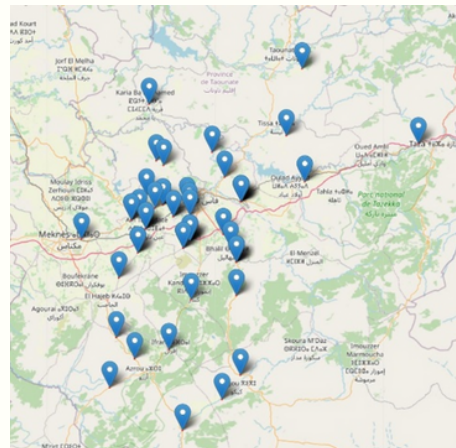


Figure I-4: GIS Map for tential EVCS

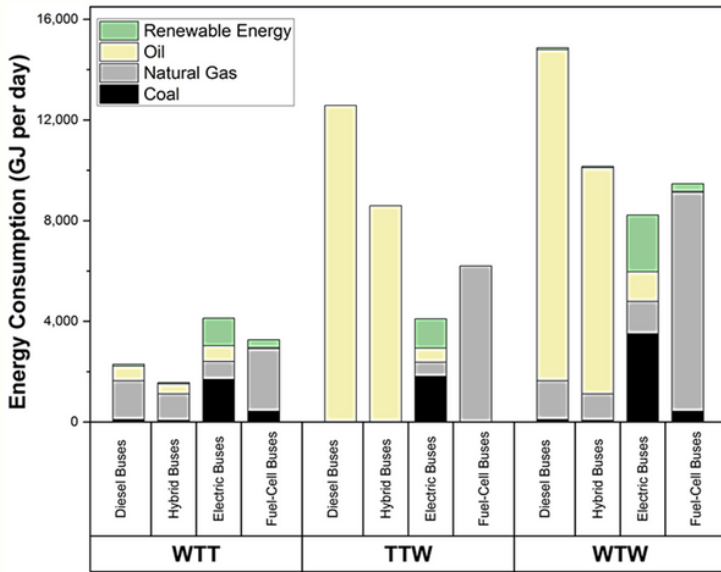


Figure II-1: Daily Energy Need of Different Bus

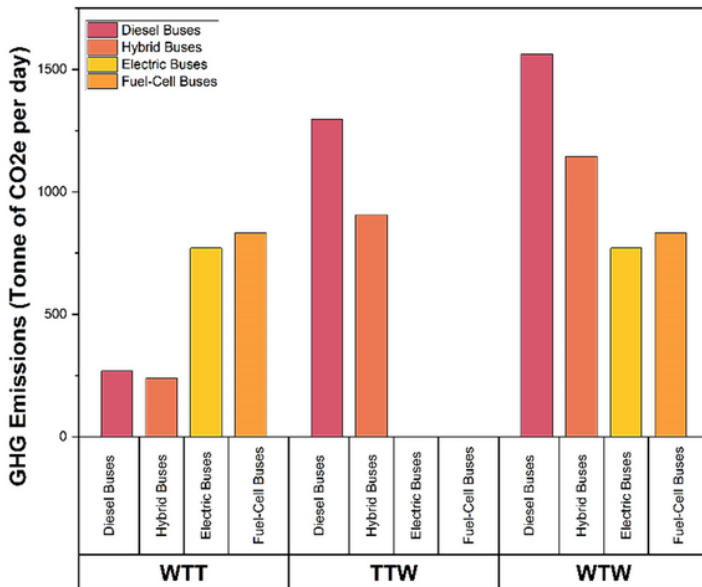


Figure II-2: Daily GHG Emissions of Different Bus Technologies

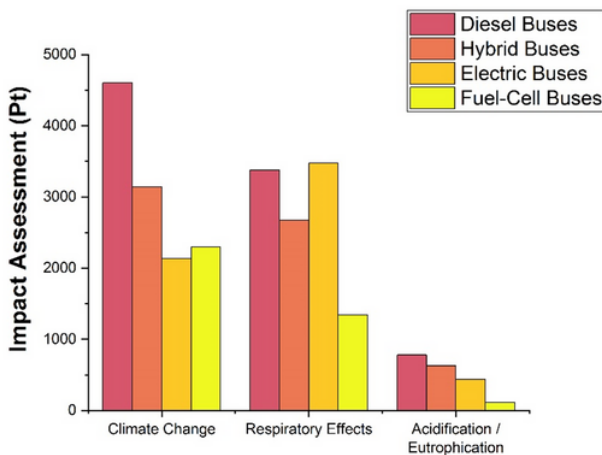


Figure II-3: Environmental Impact Assessment of Different Bus Technologies

Publication# II: Energy and Environmental National Assessment of Alternative Fuel Buses in Morocco

(<https://doi.org/10.3390/wevj14040105>)

Authors: Hamza El Hafdaoui, Faissal Jelti, Ahmed Khallaayoun, and Kamar Ouazzani

The road transport industry's heavy reliance on petroleum-based fuels, particularly in public transportation, contributes significantly to greenhouse gas emissions. Transitioning to alternative fuels with lower environmental impact is crucial for a more sustainable public transportation sector. However, applying well-to-wheel studies from developed countries to gasoline markets in developing nations presents challenges due to variations in local fuel conditions and vehicle engine technologies. This study focuses on Morocco and provides a comprehensive national-level environmental life cycle assessment of alternative buses, comparing current diesel buses to potential hybrid diesel-electric, battery-electric, and fuel-cell buses. The findings indicate significant reductions in energy consumption and greenhouse gas emissions for alternative fuel buses, with battery-electric buses leading the way at a 44.7% energy cut (Figure II-1) and 50.8% fewer greenhouse gas emissions (Figure II-2). These improvements would contribute to mitigating climate change, air pollution, acidification, and eutrophication, as illustrated in Figure II-3. However, the implementation of these changes by 2030 in Morocco will require addressing technological, financial, and institutional barriers. The study's model and approach hold relevance for other countries with developing economies.

Publication# III: Home Energy Management System Based on Genetic Algorithm for Load Scheduling: A Case Study based on Real Life Consumption Data

(<https://doi.org/10.3390/en16062698>)

Authors: Reda El Makroum, Ahmed Khallaayoun, Rachid Lghoul, Kedar Mehta, and Wilfried Zorner

This paper introduces a home energy management system that employs a genetic algorithm to optimize the scheduling of appliance usage within households. By considering dynamic electricity pricing, solar energy utilization, and user comfort, the system offers personalized recommendations to enhance energy handling. Leveraging historical appliance usage data and statistical methods, the algorithm incorporates user preferences. The system's performance is evaluated through three scenarios based on real-life appliance consumption data from a household in Morocco, each with varying parameters. Running the scenarios on a MATLAB script reveals cost savings of up to 63.48% compared to a base scenario for a specific day, as in Figure III-1, demonstrating the system's ability to achieve significant savings without compromising user comfort. The paper also discusses the integration of additional shiftable loads in Figure III-2, such as electric vehicles, into the household and addresses the limitations of home energy management systems. The primary contribution of this research lies in the utilization of real data and the inclusion of user comfort as a metric in the home energy management scheme.

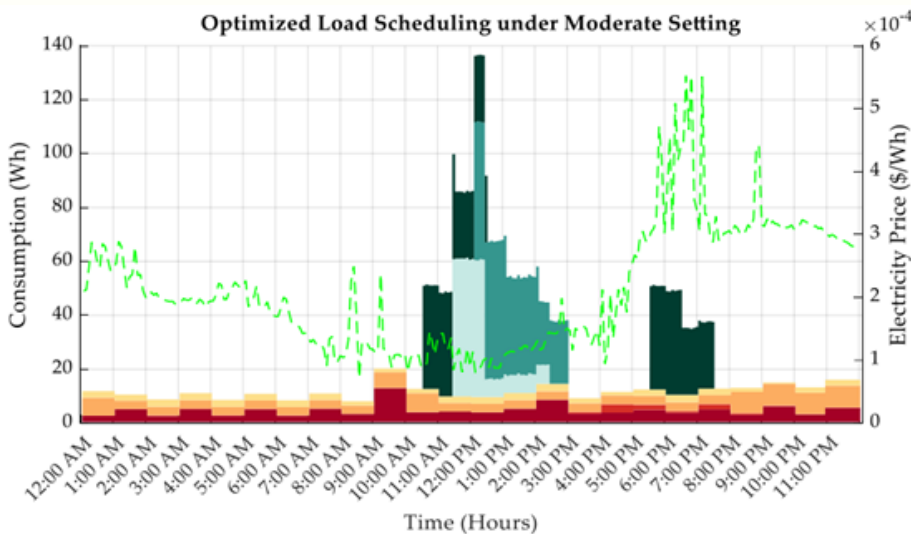


Figure III-1: Results Load - Moderate Scenario

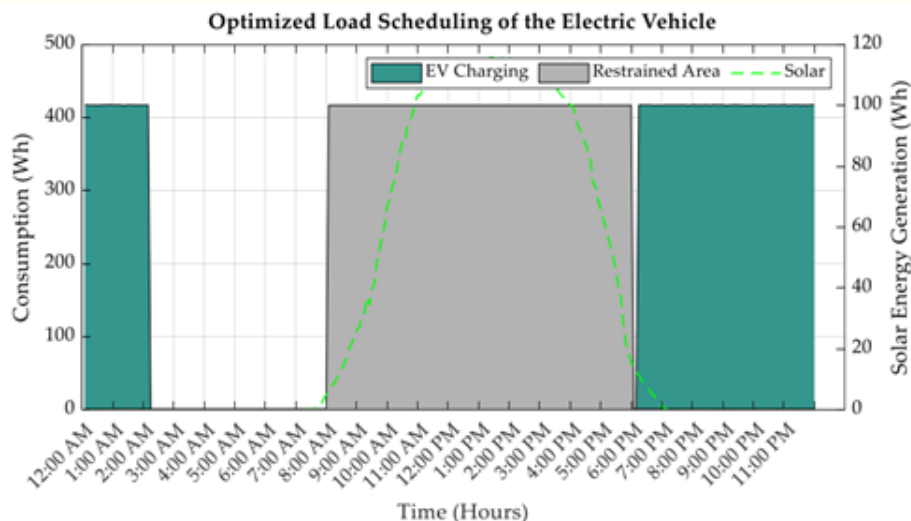


Figure III-2: Load Scheduling for EV Charging

Student of the month

Hamza El Hafdaoui

My name is Hamza, I am an AUI graduate and currently a Ph.D. candidate at the National School of Applied Sciences in Fez while being an adjunct faculty member in the School of Science & Engineering at Al Akhawayn University in Ifrane.

I have been appointed under the coordination of Prof Khallaayoun to lead the research subtopic of REMO and I have been pursuing the following topics:

- Optimal Placement of Electric Vehicle Charging Stations using Geographic Information Systems, Integer Linear Programming, and Genetic Algorithms;
- Energy and Environmental National Assessment of Alternative Fuel Buses in Morocco;
- Life Cycle Assessment of Alternative Fuel Light Duty-Vehicles in Maghreb Region;
- Energy and Environmental National Assessment of Railways in Morocco;
- Development of a Mathematical Model for Social Assessment of Alternative Fuel Vehicles;
- Forecasting of Pumped Fuel Prices in Morocco using the ARIMA Model;
- Development of a Secure Semi-Decentralized Algorithm for Renewable Energy Distribution;



AUI Student Hamza El Hafdaoui

REMO is presenting a valuable chance for me to engage in international collaboration with universities and pursue relevant research. I was able to publish three papers this year under REMO (please refer to the article in this newsletter about the research outcomes this year).

Research Stay of AUI student at THI

Reda El Makroum



AUI Student Reda El Makroum

During my 5-month research stay at InES, my involvement in the research conducted at the institute was by no means limited to the REMO project. As a matter of fact, I was highly encouraged to be involved in ongoing projects led by other researchers at InES.

Through weekly meetings, not only was I constantly aware of the progress made in other projects at the institute, but I was also offered the opportunity to share feedback and have fruitful discussions about these projects.

I was in particular involved in the project entitled FarmErgy led by researchers Akhilesh Yadav and Seyid Arikan. In this collaboration, I was able to aid in brainstorming sessions revolving around farm energy management systems, in which I could contribute my research experience to the conception and design of the system to be established for the project.

I have also used an optimization algorithm to optimize the scheduling of electrical loads related to the milking system, the feeding system, and other important loads for the operation of the farm.

Furthermore, this collaboration was of notable aid to my own work as it helped me use a brand-new set of data to test my algorithm and fine-tune my program. All in all, it was a pleasure working with Akhilesh and Seyid on this very interesting project, and I am looking forward to further collaboration in the future.

Personnel change at InES-THI and the REMO project

Carina Mwatunga, Project Coordinator (THI)

Project coordinator Philine Ginsberg left InES at the end of 2022 to take on new professional challenges. She had accompanied the REMO team since the beginning of the project and was always available to the growing REMO network with her open-minded nature and commitment.

Carina Reddi was the interim project coordinator until Carina Mwatunga took over the project coordination beginning of April 2023. She will be available from now on for any inquiries about the project.

REMO Consortium

In Morocco:



University partners

In Tunisia:



In Germany:



Industry partners



If you have any inquiries regarding the content of the newsletter or the overall REMO project, please get in touch with the following persons:



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The REMO project is funded by DAAD with funds of the German Federal Ministry for Economic Cooperation and Development (BMZ).