Resiliency Analysis for the Development of Microgrid Architecture against Climate-Driven Events in the Dominican Republic's Electric Systems

QUARTERLY TECHNICAL REPORT (15/04/22 -15/07/2022)

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PUCMM
Pontificia Universidad Católica Madre y Maestra

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1. Ongoing Research

1.1. OpenDSS-Based Distribution Network Analyzer in Open-Source GIS Environment Implementation in EDENORTE (VOLG101).

The ongoing work is focused on solving the technical challenges that have arisen when transcribing EDENORTE's information, contained in the Geographical Information System (GIS), to the OpenDSS terminal.

To reduce complexity and to address the current challenges, while also testing the software capabilities and flexibility, the selected distribution networks were reduced significantly and split into 22 different polygons containing around 7,500 clients.

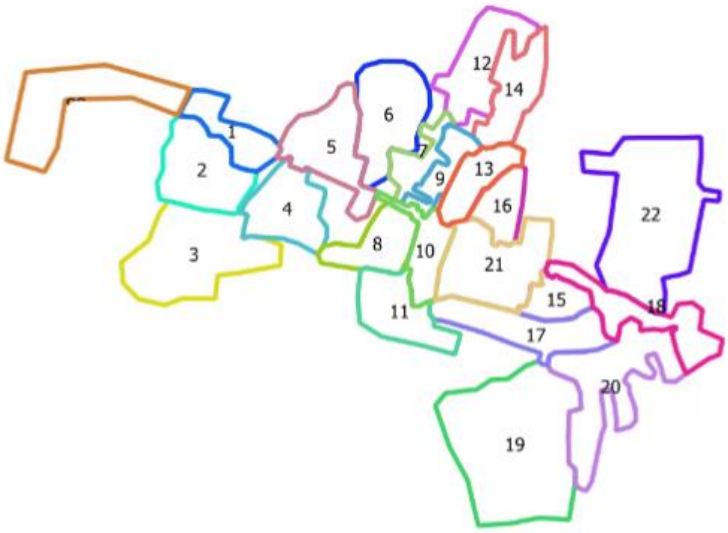


Fig 1 – All Polygons VOL 101 (~7,500 Loads)

For example, figure 2 contains only 306 loads, which significantly reduces the complexity of the simulation allowing the modelers to look for errors more quickly.

Fig 2 - Polygon 1 out of 22 - VOLG 101 (306 Loads)

After clearing errors in all reduced polygons, the GIS individual layers were merged. Upon further testing all errors regarding the QGIS2OpenDSS plugging have been resolved for the 7, 500 loads (see Fig. 3) and the resulting Distribution System Simulator archives were generated (See. Fig 4).

Fig 3 - Merged Polygons - VOLG 101 (~ 7,500 Loads)

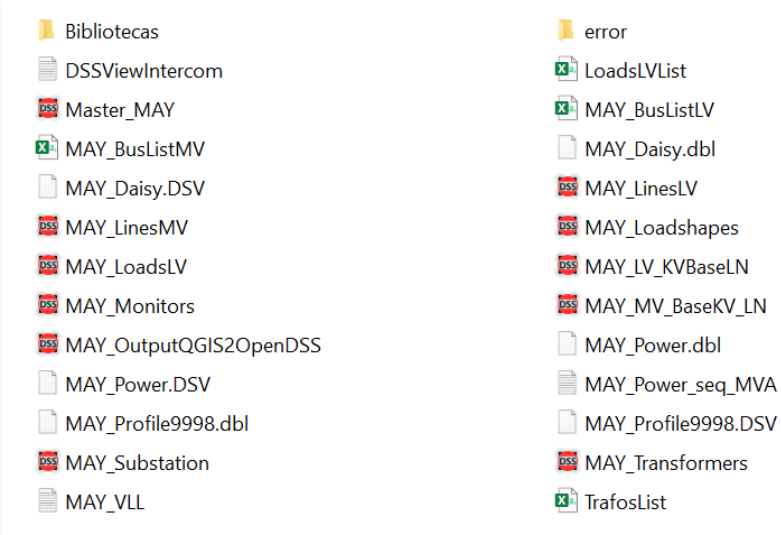


Fig 4 - Generated OpenDSS files - VOLG 101 (~ 7,500 Loads)

1.1.1. Initial results- OpenDSS Snapshot Simulation | Working Table with University of Costa Rica (UCR)

Initial simulations were run using the Snapshot Mode, which performs a single power flow solution under static conditions. Upon inspection of the simulation results, an unusually high level of distribution losses were found (see Fig. 5). When analyzing the simulation exported voltages by bus, the team found around 800 buses that showed 0 voltage. After a lot of time was invested in figuring out the reasons the team hit a knowledge barrier.

The team reached out to the University of Costa Rica (UCR) professor Dr. Jairo Quirós-Tortós, one of the QGIS2OPENDSS developers, which after inspecting and reviewing the code, pointed some possible solutions:

1. Reviewing voltage levels by Power Delivery Element (Line Object, Transformer Object)
2. Reviewing voltage levels by Power Conversion Element (Load Object).

This is the process the team is currently running by July 2022.

```
Results for Actor ID # 1
CPU selected : -1
Status = SOLVED
Solution Mode = Snap
Number = 100
Load Mult = 1.000
Devices = 22495
Buses = 12651
Nodes = 24832
Control Mode =STATIC
Total Iterations = 3
Control Iterations = 1
Max Sol Iter = 3

 - Circuit Summary -

Year = 0
Hour = 0
Max pu. voltage = 1.0781
Min pu. voltage = 0.51187
Total Active Power:  6.66745 MW
Total Reactive Power: 1.65136
Mvar
Total Active Losses:  0.922708
MW, (13.84 %)
Total Reactive Losses: 0.949448
Mvar
Frequency = 60 Hz
Mode = Snap
Control Mode = STATIC
Load Model = PowerFlow
------------------------
```

```
Clear

New Circuit.MAY  baseKV=69 pu=1.0  r1=0  x1=0.001  r0=0.0001  x0=0.001

redirect Bibliotecas/bibliotecas.dss
redirect MAY_LinesMV.dss
redirect MAY_Substation.dss
redirect MAY_Transformers.dss
redirect MAY_LinesLV.dss
redirect MAY_Loadshapes.dss
redirect MAY_LoadsLV.dss
redirect MAY_Monitors.dss
!Layer Substation: SUB_19092021
!Layers LinesMV_aer: MT_AEREA_1-22,
!Layers LinesMV_sub: MT_SOTE_1-22,
!Layers LinesLV_sub: BT_SOTE_1-22,
!Layers LinesLV_aer: BT_AEREA_1-22,
!Layers LoadsLV: CARGAS_BT_1-22,
!Layers Transformers: TR_1-22,

Set voltagebases=[345, 115, 69, 13.8, 12.5, 7.22, 4.16, 0.48, 0.415, 0.208]
Calcvoltagebases

redirect MAY_LV_BaseKVLN.dss
redirect MAY_MV_BaseKV_LN.dss

Solve

! Define bus coordinates
!Buscoords  MAY_BusListMV.csv
Buscoords  MAY_BusListLV.csv
```

Fig 5 - Initial results- OpenDSS Snapshot Simulation - VOLG 101

The team have identified that out of the 772 remaining LV buses with voltage 0, 671 are in underground LV networks. With this pattern at hand, we are currently looking at how the attributes and voltage levels are defined within the underground LV, looking for the unknown error.

Fig 6 – Location of LV Buses with 0 voltage – VOLG 101

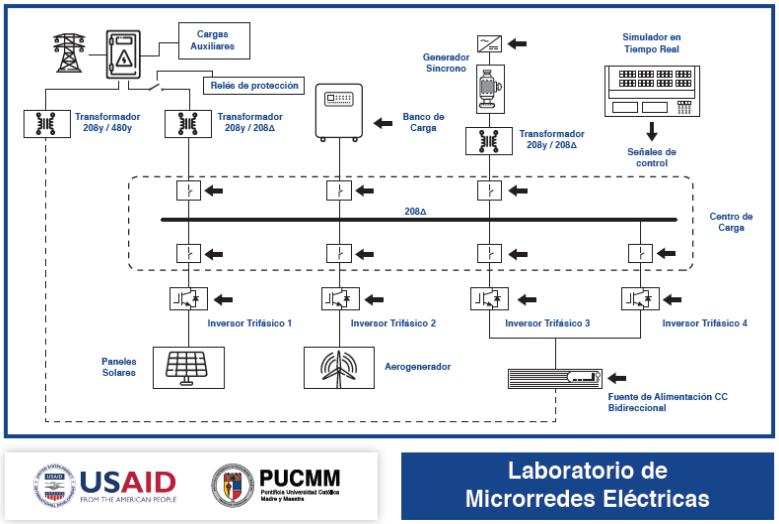
1.2. Follow up testing - OpalRT Real-Time Simulator.

A series of training were done regarding the use of the real time simulator and its inputs/outputs interfaces. It was possible to generate reference signals and monitor them using an oscilloscope. Furthermore, real time simulation testing capabilities were conducted using power electronics circuit simulations, for the validation of the integration between Matlab/Simulink® and OpalRT-Lab®.

Various signal configurations were tested under the capability of the Opal-RT platform, this includes: Analog outputs, PWM outputs, digital outputs, analog inputs and digital inputs. These verifications were done with the accompaniment of Opal-RT technical personnel.

Next steps will be focused on testing space vector modulation for the generation of three phase signals using the OpalRT XG5700. The final electrical connections for the inverters are being done and the simulation model for the generation of the space vector modulation in matlab has been validated.

1.3. Laboratory Spatial Layout



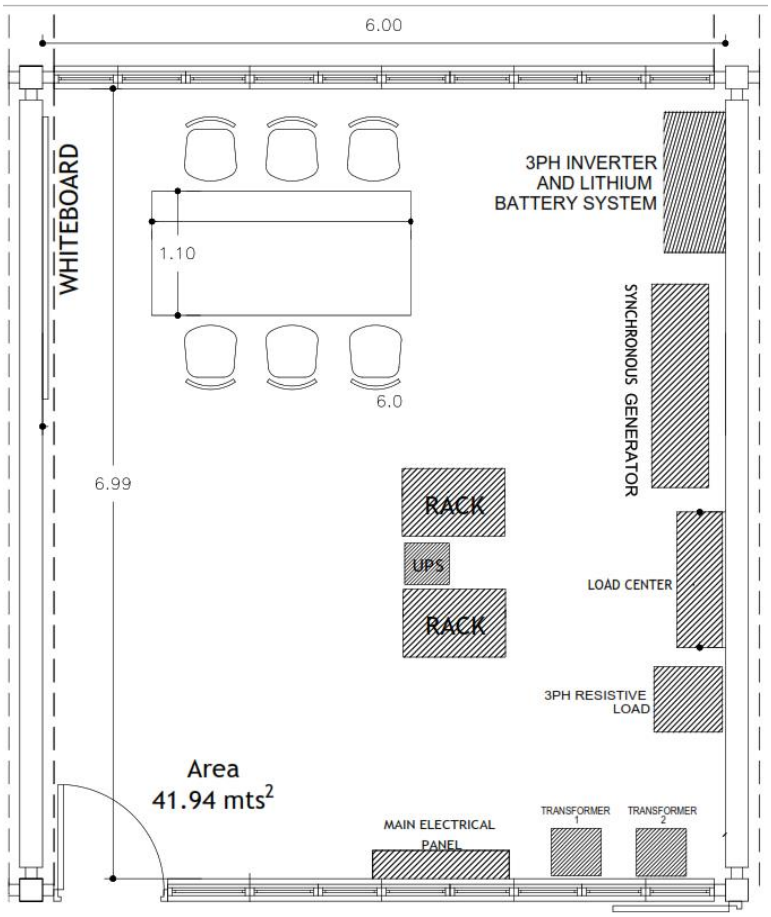


Fig 7 – Final approved layout of the Microgrid Laboratory PUCMM

Fig 8 – Installation of the 3KW PV System

Fig 9 – Installation of Wind Turbine

The final approved layout of the Microgrid Laboratory is presented in fig 7. The total budget of the laboratory renovations was USD $14,429.29, which came from PUCMM´s matching funds.

Fig 8 shows the installation of the 3kW Solar PV System, while Fig 9 shows the installation of the Wind Generator. In Fig 10, the initial spatial set-up of some of the equipment can be seen.

Fig 10 – Initial spatial set-up MG Lab

2. Project Events

During this trimester the team has not executed any project events due to our focus on solving software bugs, external communications, laboratory procurement and construction and preparing proposals for additional funding (*see 4. Outreach and Collaborations*). We are planning to execute a project presentation in the coming Sustainability Forum (*See 4.2.4*)

3. Major Equipment Purchased

Since the previous report all the equipment has arrived at PUCMM and is either installed or pending installation and testing. See 1.3

4. Outreach and Collaborations

4.1. Government Agencies

4.1.1. EDENORTE (Empresa Distribuidora de Electricidad del Norte)

During this trimester the working group designed several verification procedures for the QGIS2OpenDSS plugging, that were constructed with the QGIS architecture to automate some recurring tasks (see Fig. 11)

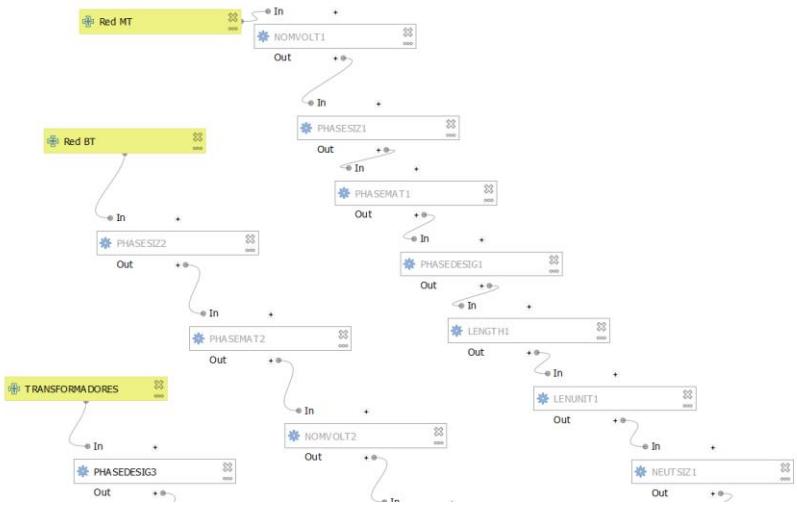


Fig 11 – Snapshot of QGIS Model which modifies several layer attributes automatically.

4.1.2. Ministerio de Educación Superior, Ciencia y Tecnología (MESCYT)

MESCYT announced the 2022 Call for the National Fund for Scientific and Technological Innovation and Development (FONDOCYT), In this FONDOCYT call, proposals for basic and applied research, Research and Development and innovation (R+D+i) or Technology Transfer will be accepted.

The Microgrid Research Team presented 3 proposals to FONDOCYT with the goal of expanding the research scope, increasing capacity building and involving more institutions from PUCMM and Government Agencies.

1. **Open Data Platform for Spatial Analysis of Energy and Community Resilience**

   See full proposal here: URL*(spanish)*

   Letter of Support: URL*(spanish)*

   The increase in human population and the use of inhabited land has brought cities closer to coasts, river basins and other points of risk, creating new situations of threat to human settlements. In addition, the increase in CO2 emissions and global temperature has increased the incidence of extreme weather events (floods, droughts, storms, erosion, sea level rise, etc.). Under this new risk scheme, it is important to identify and classify the conditions of critical infrastructures that maintain the wellbeing of citizens, within these the energy infrastructure stands out. This project proposes the use of Geographic Information Systems (GIS) software for the creation of an Open Data Platform for Spatial Analysis of Energy and Community Resilience, which will have the location of critical elements of the electrical network subject to being affected by natural disasters and anthropological factors. The combination of electrical system data with socioeconomic and geographic information will serve to illustrate the occurrence of high-impact, low-probability (HILP) events, which could affect said systems and the communities that inhabit it, through energy and community resilience indexes. Vulnerability maps will be created that will allow energy sector authorities and community leaders to examine the interaction of resilience indicators, locations of critical infrastructure, hazards, and estimated annualized frequency of hazards. The PUCMM Electrical Microgrids research group and the Center for Urban and Regional Studies (CEUR) participate in this project.

   Budget: 11,306,438.63 RD$ (206,296.71 USD$)

2. **Use of Power Hardware-in-the-Loop (PHIL) simulations for verification schemes of protections against faults in EDENORTE's electrical distribution system**

   See full proposal here: URL*(spanish)*
   Letter of Support: URL*(spanish)*

   Electricity distribution companies have significant challenges when it comes to validating new projects on distribution lines, both at low voltage and medium voltage levels. This is explained in part because traditional simulation schemes have limitations to model the behavior of all the linear or non-linear characteristics that the various elements that make up an electrical power system may present. Due to this, there is an increasing number of distribution companies at a global level that use power hardware simulation strategies in the loop to validate devices under test and new infrastructures in electrical distribution networks. This allows obtaining more accurate simulation scenarios that reduce implementation and validation times when implementing new protection schemes or modifications to distribution networks. However, in the Dominican Republic, a methodology for the use of this type of technology by local electricity distribution companies has not been established. In this way, the present project seeks to establish this methodology using the Microgrids laboratory of the Pontificia Universidad Católica Madre y Maestra in conjunction with the collaboration of the regional electricity distribution company EDENORTE. This project will provide an important reference framework to enable the use of this type of simulations in this distributor, providing a new tool that allows reducing both the cycle of development and validation of new electrical infrastructures.

   Budget: 23,407,181.10 RD$ (427,086.26 USD$)

3. **DC microgrids for the integration of bidirectional vehicle (V2G) charging systems in the electric utilities.**

   See full proposal here: URL(*(spanish)***)**
   Letter of Support: URL(*(spanish)***)**

   The exponential growth that the adoption of electric mobility has been experiencing presents a great challenge for electric utilities worldwide. The new demand requirement for electricity that this growth will generate will force major investments to be made in the restructuring of the electricity generation and distribution infrastructure. Therefore, it is important to determine the optimal electrical infrastructure to accommodate this new vehicle fleet and develop the vehicle-electric utility (V2G) nexus. DC microgrids have become an important research focus due to their ease of integration of renewable sources and their greater power

transmission capacity compared to an AC system. Additionally, the possibility of applying advanced control strategies can allow the use of the V2G concept to increase the resilience of the traditional utility in failure conditions, serving as a variable capacity storage system. For this reason, this project seeks to study V2G systems integrated into a DC microgrid and capable of interacting with the traditional electric utility. PUCMM's microgrid laboratory and simulation systems based on power-in-the-loop (PHIL) hardware will be used to integrate bidirectional V2G charging stations that can be coordinated within the microgrid. In this way, the infrastructure will be validated as a possible solution to the integration of electric mobility.

Budget: 20,832,186.48 RD$ (380,103.03 USD$)

4.1.3. U.S. Embassy Santo Domingo – PAS Annual Program

The Public Affairs Section (PAS) of U.S. Embassy Santo Domingo under the auspices of the U.S. Department of State is pleased to announce that funding is available through its Public Diplomacy Grants Program. This is an Annual Program Statement, outlining our funding priorities, the strategic themes we focus on, and the procedures for submitting requests for funding.

Purpose of Grants: PAS Santo Domingo invites proposals for programs that strengthen cultural, educational, professional, and scientific ties between the U.S. and Dominican Republic through cultural, professional and exchange programming that highlights shared values and promotes bilateral cooperation. All programs must include an American cultural element, or connection with American expert/s, organization/s, or institution/s in a specific field that will promote increased understanding of U.S. policy and perspectives.

Microgrid Research PAS proposal ideation

Our society’s high dependency on electrical energy indicates the importance of correctly handling the distribution, generation, and consumption of this resource. Nevertheless, there is an important need in Dominican Republic’s electrical energy sector for the adoption of the latest trends in management, coordination, and control of the operation of electrical distribution networks. To that end, this project aims to procure funding to organize a series of academic and professional lectures in collaboration with the University of Puerto Rico at Mayagüez (UPRM) directed towards final year electrical engineering students and professionals currently working in Dominican Republic’s electrical sector. The Pontificia Universidad Católica Madre y

Maestra (PUCMM)'s Microgrid Laboratory (sponsored by USAID and NAS PEER program grant number 9-140) offers the perfect setup for the development of a series of training sessions related to electrical power system simulations and implementation of electrical smart grid technologies. Professor Fabio Andrade is the Director of the Sustainable Energy Center (SEC) at UPRM, this center has had vastly experiences regarding the simulation and creation of control strategies of power systems, promoting these exchanges will greatly improve the proficiency of electrical engineering students and professionals that will take part in this series of training. Furthermore, a better understanding of these future trends in the electrical sector will clearly help in the integration of technologies which could improve the resiliency of Dominican Republic's electrical sector. This improved resiliency could have great impacts in the security and stability of Dominican Republic's entire society. Finally, this project will be a key enabler for the creation of new study programs which will relay on the Microgrid Laboratory and promote higher level education in the form of master or doctoral programs.

4.2. Non-Governmental Organizations

4.2.1. Energy Shared Technology between Europe and Latin America (ESTELA).

URL: Full proposal

ESTELA strives to accelerate the emergence and deployment of a successful, collaborative, user-centric, and FAIR energy data ecosystem shared between Europe and Latin America and Caribe, ultimately breaking down the barriers to data sharing. To do so, ESTELA will create a tangible and transferable foundation for a FAIR, inclusive, secure, and trustworthy intra-sectoral ecosystem for sharing European, Latin American, and Caribbean energy data. The ESTELA data ecosystem will be initially conceptualized for the energy sector, but will serve as a tangible and transferable foundation for the emergence of other sectoral data spaces. ESTELA will deliver a profound technical architecture for the integration of distributed databases. This considers semi-automatic fusion and aggregation of heterogeneous data. A special focus will be given to enabling higher levels of interoperability of such heterogeneous energy data, but also components and technologies stemming from distributed databases. To this end, the entire technical architecture (e.g., data exchange interfaces, connectors, APIs) developed within ESTELA will be extensively co-created in alliance with other similar data platforms such as that in EERAdata. This will not only allow for a higher degree of interoperability between data platforms to be achieved, but will also allow for informed and constructive enhancements to the system to be made based on joint learnings, best practices, and ways to overcome barriers to implementation. All of these efforts will be directed toward breaking down the barriers to data sharing and motivating wide participation in data exchange activities within the

energy sector. Likewise, several social science and humanities, and environmental studies will be performed in order to assess how the citizens can approach the digitalisation of the energy sector and how the energy impacts climate change and biodiversity.

Microgrid Research Team Proposal

Scientific description

Increasingly frequent climate-driven events and the rising growth of renewable energies assets have highlighted the urgency to improve grid resilience and sustainability. But, to create a more resilient energy infrastructure and to achieve the vision of a more renewable use of our resources, a different design for energy management is needed. The grid of the 21st century will require advances in transmission and distribution system management, with algorithms to control, segmentate (microgrids), and optimise how power is transmitted and distributed through the grid. However, most energy databases are unfit for the use of advanced analytical tools, causing forgone opportunities that arise from digitization. This project will apply the FAIR Guiding Principles on Renewable Energy, Power Transmission, and Distribution Networks Data of the DR Energy Grid.

Technical description

This use case aims to create a library of publicly available test data from a subset of the Interconnected National Energy System (SENI) of the DR, applying tools from the FAIR/O ecosystem (findability, accessibility, interoperability, re-usability and openness of data), such as joint ontologies, metadata standards, etc. This information will benefit government and academic research in various ways by providing access to fast and easy research of data and metadata, facilitating interoperability from different stakeholders and providing open data repositories. At PUCMM we have the computational services and expertise from the School of Computer and Telecommunications Engineering, these will be used to create a virtual environment where production and validation environments will be created for the data aggregation and post-FAIRification process.

4.2.2. EATON

EATON, a manufacturer of electrical equipment with local production, was contacted to strengthen relations and offer the laboratory and research resources for the creation of inter-institutional agreements. EATON was interested both in equipment donation and in collaboration for its research and development department, and the conversation is kept open waiting on them to finish a new Engineering location in Santo Domingo that is under construction.

4.2.3. Centro de Estudios Urbanos y Regionales (CEUR) – PUCMM

In order to continue contributing to the development of different socioeconomic and structural areas that are important for energy and community security in the Dominican Republic, the Research Group on Energy Resilience and Microgrids of the School of Electrical and Mechanical Engineering, and the Center for Urban Studies and Regional (CEUR), both attached to the Vice-Rector for Research and Innovation of the Pontificia Universidad Católica Madre y Maestra (PUCMM), presented a grant to the National Fund for Scientific and Technological Innovation and Development (FONDOCYT) (*see section 4.1.2*).

4.2.4. Foro de Energía Sostenible (FES)

The microgrid research team is once again invited to present the project results and scope at the next Sustainability Forum, an activity organized by Ritmo Económico Magazine, within the framework of World Efficiency Day. This forum aimed to publicize the protagonists of the Energy Transition in the country, as well as their plans, decisions and impact on the economy and the environment.

URL: https://foroenergiasostenible.com/

4.2.5. Agencia de Cooperación Alemana (GIZ) – Proyecto de Transición Energética

URL: Green hydrogen: technical fundamentals, economics and applications

The microgrid research was invited to participated in the technical workshop "Green hydrogen: technical fundamentals, economics and applications".

Context:

Out of the technical cooperation between the Energy Transition Project implemented by GIZ Dominican Republic and the Renewable Energies and Energy Efficiency program (4e), implemented by GIZ Chile; The study “Prospective Analysis of Green Hydrogen in the Dominican Republic” has been published.

The objective of this study was to know the current international situation of green hydrogen, as well as the prospective of the Dominican Republic, considering the potential applications and implications in the country, and was prepared as input to the Ministry of Energy and Mines for its energy policy. For this, the study surveys the status of hydrogen at the international level and an evaluation of the technical and regulatory infrastructure of the local energy sector. With these inputs, the main challenges and opportunities that the country has for the development of green hydrogen are identified, and some recommendations are listed.

5. Technical Research Presentations

During this trimester the team have not executed any Technical Research Presentation due to our focus on solving software bugs, external communications, laboratory procurement and construction and preparing proposals for additional funding (*see 4.Outreach and Collaborations*). We are planning to execute a technical presentation in the coming trimester, when either the laboratory installation is completed or the OpenDSS simulation results are align with the benchmark data from EDENORTE.

6. Potential Development Impacts

6.1. Capacity building in Research

As part of his PhD Research, CI Rafael Batista is conducting research on the use of biological inspired optimization techniques for the consensus making on the formation of networked microgrids in order to enhance resiliency and operational characteristics of the electrical grid. Swarm Intelligence (SI) is being explored with the particle swarm optimization algorithm (PSO) and validated using a simulation of an IEEE benchmark system for the testing of networked microgrids, presented in (Alam et al., 2020).

Currently work is being done in the solution of the power flow equations for this benchmark system, which allows multiple reconfigurations by the activation of redundats

points of power coupling (PCC) for each microgrid presented. The decision of activating/deactivating PCC, increasing or reducing generation, and demand management will be done by the optimization algorithm. Various constraints are being included in the optimization process related to: serving critical loads, reducing transmission losses, improving operational cost, and minimizing power requirement from the central utility. This work will be the fundamental part for the reconfiguration ability for improved resiliency proposed by this project.

7. Challenges

7.1. Budget constrains in the re-building of MG Research Lab.

Unexpected delays have arisen regarding the adequation of the selected space for the Microgrid Laboratory. Securing the required budget for covering these activities was a process that took longer than expected. Furthermore, the purchasing process of the needed materials for the reconstruction and some adjustment to the building electrical installation that needed to be done, contributed to these unexpected delays. All these adequation activities were challenging for the project because there were limitations of the available funds.

Also, security requirements (access control, camera surveillance, and fire detection) and the air conditioning of the selected space were completed but these also contributed in the presented delays.

7.2. Software Bugs

The main challenge so far has been the process of finding and fixing software bugs in the OpenDSS and QGIS plugins. This is mainly due to the high learning curve and the arduous process of cleaning the existing data from EDENORTE. Another important challenge in the medium term will be the creation of shared simulation environments between OpenDSS and MATLAB that remains crucial to the objectives of the research.

8. Future plans

Ongoing research (3-6 months)

8.1. PUCMM Chapter of IEEE PES

Conversations are being held with IEEE Dominican Republic Section to start a student's chapter of the Power Electronic Society. This will be created around the Microgrid Laboratory and the objective will be to align the activities of these chapters with projects and activities related to microgrid integration, enhanced electrical grid resiliency, and managing of energy resources for sustainable development.

8.2. Technical Presentations and Training Activities

8.3. Development of additional training courses on OpenDSS and Matlab/Simulink

The main platforms/software to simulate the electrical grid components and interactions have already been identified by the team, as well as training courses on how to utilize them were already developed to build capacity among the students and professionals that will interact with the project. This will serve as a platform for developing future work and investigations. The team will organize workshops on the use and capabilities of these two tools for developing Power Systems simulations and to address studies on specific electrical grid issues. The training courses and workshops will be held at PUCMM with the support of the Engineering faculty and student's committee. Furthermore, these training courses will help the integration of future students into the project as well as serving as a base for the development of the engineering curriculum of the local universities.

8.4. Development of additional training courses on QGIS and OpenDSS integration

The integration of OpenDSS and QGIS has been crucial to have the capability of representing the existing large distribution networks and its components in the scripting language of the OpenDSS software. There are several plugins available under the QGIS stack that help correct and filter the information prior to its translation into the scripting language, as such a course on these special plugins will be very convenient to be linked to the previous OpenDSS course, giving it a broader applicability.

8.5. Testbed Integration

Currently the team is working on the preparation of the laboratory area for the placement and initial testing of the OPALRT real time control system. Network and protected electrical connections are currently being built. The initial validation will be done without the use of the inverters. The inverters are scheduled to arrive in the Dominican Republic in mid-January. The custom clearance process and tax exemption is expected to take about one month. Additionally, we are planning to test the DC power supply in January. We expect that the resistive digital load will be in the Dominican Republic by the end of January but will also have to go through the customs clearance process expected to take a months as well.

8.6. Centro de Investigación PUCMM (Microrredes)

Efforts have been made in contacting other researchers in PUCMM interested in topics related to the transition to SmartGrids and the inclusion of renewable energy distributed generation. The possibility of creating a research group focused on this topic and the integration of the research initiatives in a single laboratory in order to optimize budget and research capabilities is being studied.

9. Additional information

9.1. Professional Development

9.1.1. ASOFER (Asociación Fomento a las Energías Renovables)

ASOFER's mission is to promote, defend and represent renewable energies in the country to promote responsible growth and protect the right to sustainable development in the Dominican Republic. C.I Abraham Espinal is already a member through his company "Enestar", and now P.I is also a member of this organization.

9.1.2. PUCMM – Rebuilding of PUCMM¨s Labs

PI De Jesús was invited and contracted to lead the Rebuilding of some of the Laboratories of the Mechanical and Electrical School. This project consists of the design and assembly of experimental modules for the Electrical Machines, Electrical Installations and Electrical Controls / Lighting laboratories. It will be worked as a degree macro project with students from IEEI, IESP, IME, professors, and auxiliary engineers. The approved budget is USD $ 91,586.15.

Electric Controls Laboratory Modules

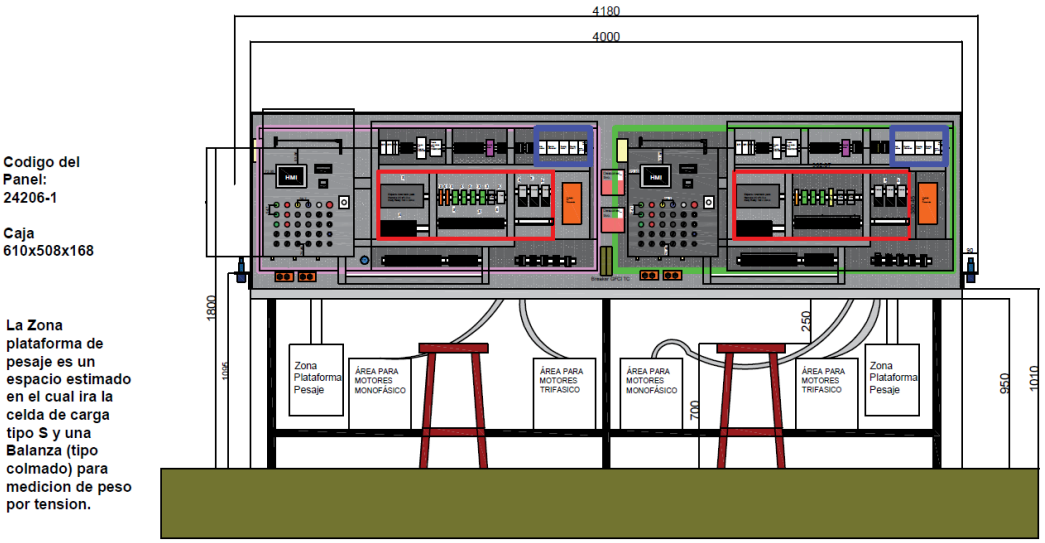


Fig 12 - Electric Controls Laboratory Modules

9.1.3. Energy Transition Podcast – GIZ – Energía Journal

Fig 13 – Promotional Art for Energía Journal Podcast

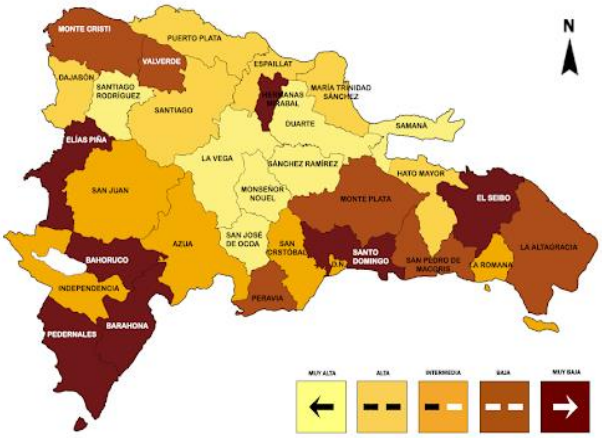
In 2017, the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH, on behalf of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (through the International Climate Protection Initiative – IKI), and the German Ministry of Energy and Mines, on behalf of the government of the Dominican Republic, agreed to implement, together with 17 other partners from the country's energy and climate sectors, the "Energy Transition Project - Promotion of Renewable Energies to Implement Climate Objectives in the Dominican Republic ". The partners of the project belong to the public, private and academic sectors.

In this podcast from Energy Journal PI De Jesus and his colleague Miguel Estévez talked with Ing. Alejandro Velázquez, Advisor on Renewable Energy and Climate Change in the Energy Transition Project, about the implications of the project and what is ahead on the agenda.

9.2. Microgrid Research Blog

The Microgrid Research blog is now hosted in the official PUCMM´s server at https://microgrid.pucmm.edu.do/, which will give the MG Research team a bigger audience to share our insights.

Fig 13 – Microgrid Research Blog hosted at PUCMM´s Server



Blog Entry 7 (January 12, 2022) | Energy and Community Resiliency Studies in the Dominican Republic. Case Study: Santiago de los Caballeros City.

This blog post came out of the research the team put together for the 2022 Call for the National Fund for Scientific and Technological Innovation and Development (FONDOCYT), where we team up with the Centro de Estudios Urbanos y Regionales (CEUR) of the Pontificia Universidad Católica Madre y Maestra to submit a proposal for the creation of a #OpenData Platform for Spatial Analysis of Energy and Community Resilience, which will have the location of critical elements of the electrical network subject to being affected by natural disasters and anthropological factors.a rapidly changing energy sector.

URL: https://microgridresearchpucmm.blog/2022/07/12/energy-and-community-resiliency-studies-in-the-dominican-republic-case-study-santiago-de-los-caballeros-city/

9.3. Research Assistant

SUMMARY OF COMPLETED TASKS (MAY-JULY 2022)

Date submitted	Completed tasks
17-May-2022	Literature review (investigation): “Open Data Platform for Spatial Analysis of Energy and Community Resilience”
25-May-2022	Assistance to conference: “Green hydrogen: technical fundamentals, economics and applications” by GIZ
15-June -2022	Literature review (investigation): “DC Microgrids For Integration Of Bi-Directional Charging Systems At The Utility Level”
4-July-2022	Physical assistance on setting up the laboratory

TASKS DETAILS:

Literature review (investigation): “Open Data Platform for Spatial Analysis of Energy and Community Resilience”: To investigate the background and state of the art in the topic of vulnerability maps. Additionally, compile different indicators of energetic resilience and community resilience as well.

Objective: To filter and organize information about vulnerability maps, and to have different options of resilience indicators in order to choose the best fitting ones.

Assistance to conference: "Green hydrogen: technical fundamentals, economics and applications" by GIZ: Participate in the conference organized by the GIZ about the fundamentals of green hydrogen and what we can expect from this technologies in the near future.

> **Objective:** To learn about the topic of utilizing Hydrogen as an energy storage medium.

Literature review (investigation): "DC Microgrids For Integration Of Bi-Directional Charging Systems At The Utility Level": Reviewing different articles about V2G technologies and filtering the most important information. Also, to research about the state of the art of Vehicle to Grid, Grid to Vehicle etc.

> **Objective:** To filter and organize information about vehicle to grid technologies and the state of the art of the topic.

Physical assistance on setting up the laboratory: Helping on the physical set up of the Microgrid Laboratory. Moving the components and helping assemble different structures to locate the components.

> **Objective:** Build the Microgrid Laboratory of PUCMM.