R&D NESTER

25 NL set 2023

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EDITORIAL

Dear Reader,

Among the many topics being handled within the Energy Transition, the following two are receiving particular attention by the players in the field:

- Automation, Artificial Intelligence (AI) and the associated need and use of data and Data Spaces
- Grids, and need to accommodate the increased electrification of society and increased flows of energy.

The topics we bring you with this edition can indeed be encapsulated inside these two topics.

On the first one, we address below:

- a communication and developments on Drones, Robots, AI and Space Data (satellite information);
- another one on AI and Big Data, and information on our project H2020 I-NERGY ("Artificial Intelligence for Energy");
- the launch of a new project in which we participate on Energy Data Spaces - Horizon Europe ENERSHARE.

On the second one, we are working in several related topics:

- grid planning, within the European project H2020 FlexPlan ("Flexibility to support grid planning");
- optimization of the use of the grid, namely transmission line assets, via Dynamic Line Rating, in the national project P2020 Optigrid ("Methodology for Analysis of Dynamic Line Capacity and Optimized Management of Electric Grids");
- methodologies for capacity allocation in the interconnection links between different geographies in Europe;
- development of nodal capacity allocation tools, as done in European project H2020 INTERPRETER.

Additionally, we also highlight our "Substation of the Future" project and its development in our real-time power systems simulation laboratory being selected as a success story in the series be OPAL-RT.

Check also our section on Literature Review addressing topics such as Heating & Cooling in the energy system, energy storage and energy transition in cities.

Finally, don't forget to test your knowledge with our popular Quiz section, this time on the Portuguese energy system, where penetration of renewable energy is one of the highest in Europe.

Enjoy your reading!

Sincerely,

Nuno de Souza e Silva

Managing Director

HIGHLIGHTS

R&D NESTER PRESENTED DRONES, ROBOTICS, AI AND

SPACE DATA AT ENLIT EUROPE

R&D Nester was present in the last edition of **ENLIT Europe** that was held in Frankfurt, Germany.

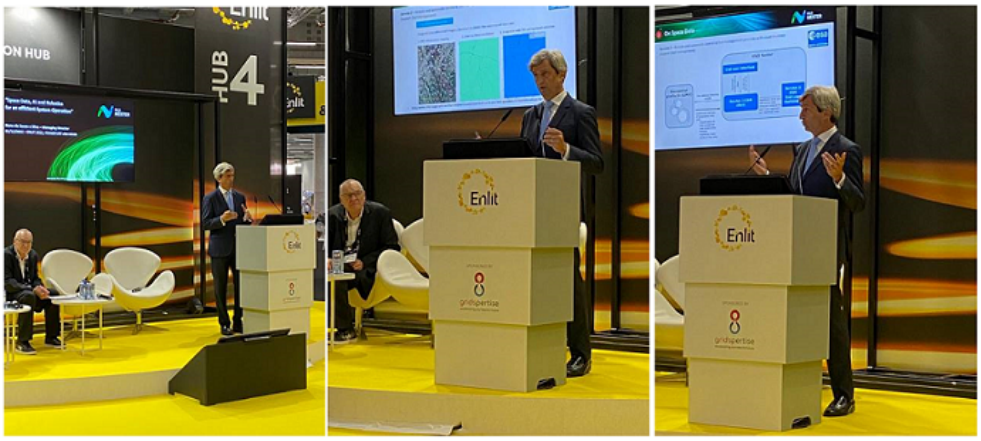
ENLIT it's an event with over 15.000 power & energy professionals which purpose is to connect people, projects and technologies in the path of energy transition.



The Partners of **ENLIT Europe** include organizations that represent the industry stakeholders and the media titles that cover the energy sector in Europe and around the world.

The organization of this event work closely together throughout the year to present the latest sector developments and industry news. This event programme always includes presentations, panels, interviews and other digital content highly relevant.

In this edition **R&D Nester** was represented in the Session "**Drones, Robotics, AI and Space Data**" of the Panel entitled "**Space Data, AI and Robotic for an efficient System Operation**". **Nuno Souza e Silva**, **Managing Director of R&D Nester**, was invited to be a speaker on this panel, where he made a presentation sharing R&D Nester' experience framing the remaining participants and assistance on the content of R&D Nester's current projects and its results and achievements.



For more information:

ENLIT EUROPE website

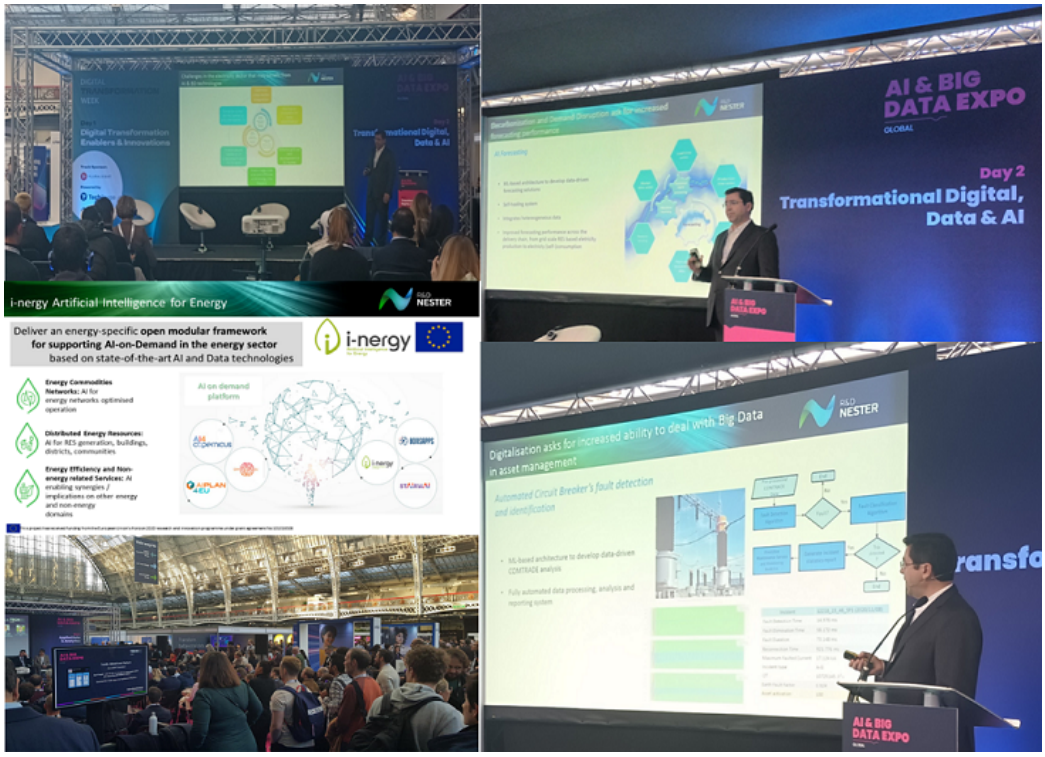
R&D Nester website

R&D NESTER AT THE AI & BIG DATA GLOBAL EXPO "AI

IN THE ENERGY TRANSITION: RESULTS, CHALLENGES AND OPPORTUNITIES" AND THE I-NERGY 2ND OPEN CALL



R&D Nester established an Info Corner on the **I-NERGY 2nd Open Call at the AI & Big Data Global Expo** in London, with a stand for the two days and a talk on the track Transformational Digital Data and AI, entitled **"AI in the energy transition: Results, challenges and opportunities"**.



The **AI & Big Data Global Expo** gathered professionals on IoT, Blockchain, Cyber security and cloud, edge computing and digital transformation. In direct interactions with these professionals, R&D Nester collected the interest to participate in the I-NERGY 2nd Open Call from more than 10 companies with background and showcases in the energy sector.

Nuno Pinho da Silva, R&D Nester's Researcher, delivered the **talk "AI in the energy transition: Results, Challenges and Opportunities"** highlighted results obtained in the I-NERGY, as well as the I-NERGY pilots and the project's 2nd Open Call. In the audience, there were more than 50 people from 31 different companies, ranging from public institutions to SMEs and start-ups.

With the **I-nergy**, **R&D Nester** is addressing two use-cases in the Portuguese pilot:

<u>AI for enhanced network assets predictive maintenance, integrating off-grid data with condition-based monitoring:</u>

This use-case addresses the problem of developing predictive analysis for the health of Circuit Breakers to support condition-based maintenance strategies.

The results obtained so far include:

- Machine Learning based architecture to develop data-driven COMTRADE files analysis
- Fully automated data processing, analysis and reporting system
- Asset maintenance dashboard to support condition-based maintenance policies, relying on the developed survival function for circuit breakers (considering different models for each voltage level)

AI for network loads and demand forecasting towards efficient operational planning

This use case is considering the forecasting of the National load and at the TSO-DSO interface for the day-ahead operational planning.

The results obtained so far include:

- Time-series processing and feature engineering
- Development of stacking methodologies to aggregate the members using XGBoost and Pattern Sequence Forecasting with different clustering algorithms (k-Means, Agglomerative clustering and SOMs), with improved performance for the National Load forecasting
- Development of incremental learning methodologies based on the adaptive random forest method with the incorporation of the ADWIN to detect drifts and adapt to them without re-training, which decreases the data and time of the adaptation, while improving the performance of TSO-DSO interface net load forecasting.

The **I-NERGY project** is founded by the European programme H2020. This initiative gathers 17 partners with the aim to support and develop new AI-based energy services and reinforce the service layer of the EU AI-on-demand platform (ai4europe.eu) on the energy sector.

More information:

AI & Big Data Expo Global 2023 event website

I-NERGY Project website

I-NERGY Project @ R&D Nester website

R&D NESTER PRESENTED NODAL CAPACITY ALLOCATION TOOL AT MEDPOWER

R&D Nester was present in the last edition of **MEDPOWER - Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion**.

The 13th edition of the **Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion** was held in Valletta, Malta, from 7 to 9 of November 2022.



MEDPOWER2022 provided the opportunity for engineers, scientists, technicians, researchers, scholars, and companies to exchange ideas and discuss the latest research achievements in academia and industry. The conference also provided a forum to create opportunities for networking and collaboration through a series of presentations, talks, exhibitions, and special sessions. The conference covered all aspects of the power system market, design, operation, and planning, including the integration of ICT and energy systems as well as addressing challenges in the future energy markets.





In this 13th edition, **R&D Nester** presented a paper titled "**System-wide Nodal Capacity Allocation Applied to a Spanish Distribution Network**".



The content of this presented paper was produced in the scope of R&D Nester's participation on the H2020 project **INTERPRETER,** in which several planning and operational tools for Distribution Operators were developed.

R&D Nester developed two planning tools, one of which, the **Nodal Capacity Allocation** tool, provided the material used for the creation of the presented paper.

The tool itself provides a system-wide analysis on a distribution grid's ability to absorb power injection, determining at each bus how much power can be injected before any overloads or overvoltages occur in

the grid.

The tool maximizes total power absorption at the system level without compromising on operational safety limits. To achieve this outcome, a **Genetic Algorithm** is used to simultaneously maximize nodal injection at every bus of the grid (or any bus set that the user so wishes to maximize for).

In the paper **R&D Nester** delivered an explanation on the tool's methodology and presented validation results using a digital-twin from a Spanish distribution network.

For more information:

MedPower 2022 Conference

INTERPRETER website

INTERPRETER @ R&D Nester website

INTERPRETER @ LinkedIn

R&D NESTER IN ENERSHARE PROJECT: DEVELOPING THE FIRST COMMON EUROPEAN ENERGY DATA SPACE

ABOUT ENERSHARE PROJECT:

Enershare
The Energy Data Space for Europe

- The Enershare project will develop and deploy a unique and first of its kind Common European Energy Data Space that will significantly contribute to transform and digitize the energy industry on "intra-energy" and "cross-sector" levels;
- The project will allow to set up a level playing field for data sharing and aim at creating a single market for energy assets, including energy and computational assets, energy data, energy services, to be shared and exchanged across sectors efficiently and securely within the EU;
- Common European Energy Data Space enables access, control, share and reuse of large masses of currently dispersed energy data for private consumers, energy and non-energy business stakeholders, regulated operators and the public sector that will make the energy industry more secure and sustainable.



A consortium of international leaders and market drivers from the energy industry and science has launched the **Enershare** project, funded with 8 million euros by the European Commission. The main objective of the project is to develop and deploy the first of its kind Common European Energy Data Space Reference Implementation and provide a stack of data-driven cross-value chain services at the interplay of energy, non-energy and Data value chains to enable a consumer-centric participatory data-driven energy system. **Enershare** will accelerate the digitalisation of the energy sector, through the upscale of a variety of technological building blocks, including interoperability, trust, data value and governance. The project is relevant to the European goal of developing a Common European Energy Data Space, as announced in the European Strategy for Data.

The major concept of **Enershare** is to develop and demonstrate a European Common Energy Data Space which will deploy a trusted, secure and sovereign level playing field for energy data sharing and exchange among energy and non-energy stakeholders as well as it will span over two meaningful pillars: an "intra-energy" Data Space, aimed to design and demonstrate an "intra-electricity" and "across energy sector" trusted data exchange; and a "cross-sector" Data Space aimed to design, operationalise, and harmonise at EU level the beyond energy and cross-sector technology enablers for trusted, secure, sovereignty preserving data exchange. Therefore, it will significantly evolve the energy industry and make it fully sustainable as private consumers, energy and non-energy business stakeholders and regulated operators can make available their energy data, assets, and services. They can also access, share and reuse large sources of currently fragmented and dispersed data by leveraging on data-driven cross-value chain services and Digital Twins for various energy-related purposes.

"It becomes urgent to move forward the development of a Common European Energy Data Space. One of the key actions presented in the EC Recommendation for Energy System Integration is to streamline

and deploy a Digitalisation of Energy Action Plan which could accelerate the implementation of digital solutions along a more integrated energy system, by leveraging on the seamless and interoperable data-driven interaction among energy and beyond stakeholders. Such huge demand for information requires new concepts, architectures, solutions, governance and business models suitable to the energy domain on how to share, trust and exchange data efficiently among and across energy and non-energy stakeholders", - commented Dr. Massimo Bertoncini, Project Coordinator of **Enershare**, R&D Program Director for Digital Energy at ENGINEERING.

THIRTY-ONE CONSORTIUM MEMBERS ARE COMBINING THEIR FORCES

The **Enershare** project, led by digital transformation key player ENGINEERING, comprises thirty-one consortium partners from Finland, France, Germany, Greece, Italy, Latvia, Luxembourg, The Netherlands, Norway, Portugal, Slovenia, and Spain. They are international organizations from energy sector, relevant industries, research institutions and academies as well as providers of digital transformation services in open standards and various energy sectors analysis: Asm Terni S.p.A, Basque Energy Cluster, Comsensus, Depa Commercial, Electricite De France, Elektro Celje, Elektro Ljubljana, Eles, Emotion, Engie, Envirodual, European Dynamics Luxembourg, European Dynamics, FIWARE Foundation, Fortum, Fraunhofer-Gesellschaft, Hine Renovables, INESC TEC, International Data Spaces Association, Komunalno Podjetje Velenje, National Technical University of Athens, Nokia, R&D Nester, RWTH Aachen, Smart Energy Lab, Smart Innovation Norway, Tecnalia Research and Innovation Foundation, The Latvian Environmental Investment Fund, TNO, Trialog.

INTEROPERABILITY, TRUST, DATA VALUE: THREE INNOVATIVE LEVELS TO DIGITIZE THE ENERGY SECTOR

Over the next three years, the project consortium will develop and provide a Reference Implementation for a Common Energy Data Space which will leverage on the leading-edge Data Space architectures by International Data Space Association (IDSA) and European cloud initiative GAIA-X. It will enable to set up a level playing field for data sharing and aim at creating a single market for data to be shared and exchanged across sectors efficiently and securely within the EU. Thus, private and public entities can fully control the use of the data they generate, and both businesses and the public sector have easy access to a large pool of high-quality data. The **Enershare** concept is based on three levels:

1. Interoperability and Data Space technological building blocks - Supporting the EU Strategy for Data acknowledges that Data Spaces should be interconnected and interoperable, **Enershare** will achieve the main Energy Data Space challenge consisting of two significant directions: first, it is providing interoperability among electricity and other non-electrical carriers, like for example, heat or gas; and second, interoperability among energy and non-energy domain like buildings, mobility, water, health or financial. Both directions will be successfully implemented by evolving and enabling standardisable and open, interoperable interfaces and APIs at the interplay among electricity and other energy and non-energy sectors, and leveraging on open standards, such as FIWARE ETSI Context broker, SGAM, CIM, SAREF.
2. Trust and sovereignty for data sharing culture - **Enershare** will build on IDSA and GAIA-X Conceptual Architectures and will include in the IDSA Connector for Data Provider and Data Consumer energy-domain trust and sovereignty building blocks and functionalities adaptation, such as Federated Identity Management and Data Usage Policies definition. The project will also leverage on adaptation of Blockchain solutions to increase trust among stakeholders and data space operators or owners. It will enable trusted and full sovereign data sharing and exchange, keeping data owners in full control of their data.
3. Data Governance Mechanisms and Data Value Stack - Data Value Chain assets, including data sources, data services, computing infrastructures, and data storage resources, will be valued, exchanged and reciprocally compensated in a financial and non-financial way by leveraging on a digital blockchain and smart contracts-based marketplace with different energy resources, assets and services. For example, it can be exchanging energy data against surplus of energy, renewable assets, smart home flexibility assets maintenance to social assistance or care services to more vulnerable people, such as elderly people. The development and deployment of the **Enershare** Data Value Stack will increase individual energy consumers participation in energy data sharing, based on the opportunity for data valuation and beyond-financial compensation.

For more information:

Enershare project website

Enershare project @ R&D Nester website

This project has received funding from the European Union's Horizon Europe Research and Innovation programme under the Grant Agreement No 101069831.

GEOGRAPHICAL ISLANDS FLEXIBILITY: FURTHER DEVELOPMENT TOWARDS THE END OF THE H2020 GIFT PROJECT



The **GIFT** consortium met for the seventh time last October at Sylfen premises, in France.



GIFT is an innovative project that aims to decarbonise the energy mix of European islands, making use of the flexibility available in distributed loads and storage, and involves 17 partners from 7 countries: INEA and ETREL from Slovenia, INTRACOM and CRES from Greece, Sylfen, Trialog, Odit-e, ARMINES and Euroquality from France, Elestor from the Netherlands, Hafenstrom, HLK, Harstad Kommune and NTNU from Norway, Sapienza University and Comune di Procida from Italy, and **R&D Nester** from Portugal.

R&D Nester's main responsibilities in this project are:

- Enhanced prediction system (nodal prediction of net load and demand response), and
- Procida grid simulation in closed loop with local measurements.

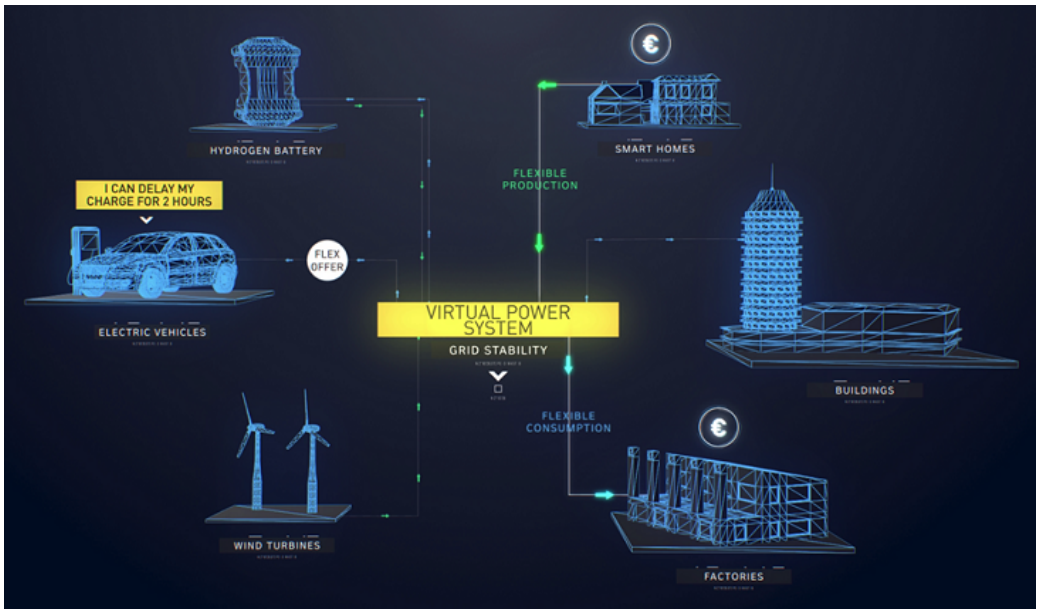
After a brief revision of the finished work by the project coordinator, the whole team dove in the project topics and the running work packages progress.

The Consortium reported the successful installation of metering equipment in the demonstration site of Procida (Italy). The installed smart meters will provide DMS data to the project and will enable the improvement of Procida grid estimations, performed by R&D Nester. Regarding the installation of the Smart Energy Hub in Procida, a new location (instead of the initially planned city-hall) able to satisfy all the safety and regulatory requirements was found, and the consortium announced that the installation will start in the upcoming weeks.

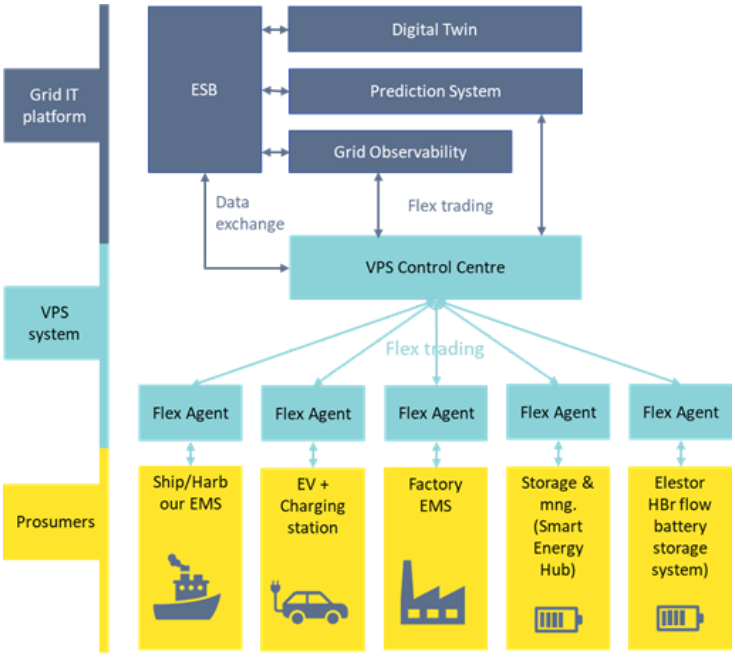
In what concerns to project exploitation and replicability of results, fruitful discussion take place during the meeting for the deployment of GIFT's solution in follower islands, namely the Greek island of Evia.

During the meeting, all participants were invited to visit Sylfen facilities where a hybrid hydrogen storage and CHP system "Smart Energy Hub" is being developed. The "Smart Energy Hub" aims to maximize the energy auto-consumption of a building or groups of buildings by using hydrogen as an energy vector to store the surplus electricity from renewable energy sources to re-inject it back into the grid when needed. As an innovative green energy technology, it relies on dynamics software that receive inputs from in-field monitoring to enhance its efficiency.

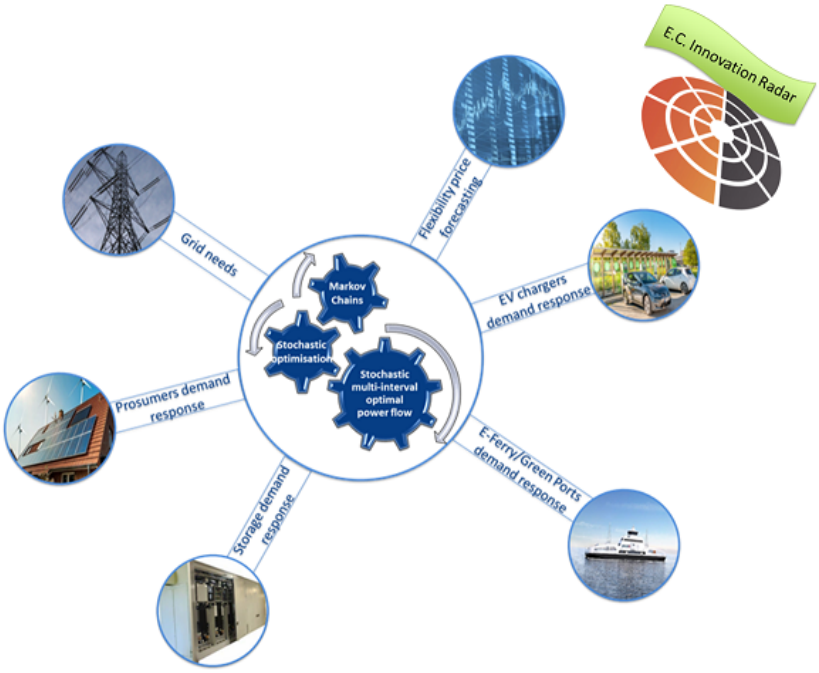
The GIFT project develops the concept of Virtual Power System:



The Virtual Power System is enabled and supported by the GIFT system, with the following architecture:



The GIFT project developed innovations recognized by the European Commission Innovation Radar, namely the [R&D Nester's Enhanced Prediction System]:



For more information:

Gift Project website

GIFT project @ R&D Nester website

DYNAMIC LINE RATING P2020 OPTIGRID PROJECT FINAL DEVELOPMENTS

R&D NESTER organized the final meeting of **OPTIGRID** project at its facilities in Sacavém last month of October.

This project final meeting occurred in a hybrid format, with the presence of **LNEG** and **R&D NESTER** elements both physically and remotely.







The purpose of this meeting was to complete the last important milestone related to the closing meeting of the project.

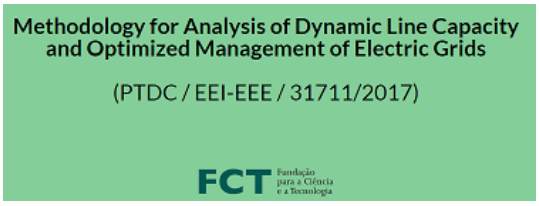
A general review of the work accomplished on the OPTIGIRD project was carried out, as well as the verification of the completed tasks and the tasks to be completed.

Almost all KPIs were achieved, with exception for academic internships because of the pandemic.

It was also approached the recent workshop held at LNEG' facilities last month of September and the subsequent disclosure of the relevant stakeholder to this topic.

R&D NESTER also provided a visit to its real-time simulation lab for the elements of **LNEG**.

This **OPTIGRID** project with the partnership between **R&D Nester** and **LNEG** lasted for 48 months, started in 2018 and ending now in 2022.



The project was financed by the P2020 program.

Disclaimer and financing programme/entity: Project PTDC/EEI-EEE/31711/2017 submitted under the call for tenders (AAC) No. 02 / SAICT / 2017, funded by national funds through the budget of the Foundation for Science and Technology (FCT).

More information:

OptiGRID Project website

OptiGRID @ R&D Nester website

R&D NESTER PRESENTED FLEXPLAN PROJECT INNOVATIVE GRID PLANNING TOOL AT SEST 2022

The 5th edition of the **International Conference on Smart Energy Systems and Technologies** was held in Eindhoven, The Netherlands, from 5 to 7 September 2022.



The area of smart energy systems and technologies has witnessed both impressive growth and significant investments in recent years. Smart energy systems and technologies enable more efficient management of energy usage and supply and better planning for outage response and recovery, as well as the integration of heterogeneous technologies such as electric vehicle networks, renewable energy systems and connected consumers. Nonetheless, major research questions and engineering challenges remain, particularly in the light of increasing data streams from different parts and components of energy systems and the need to enhance their physical and cyber resilience.

SEST 2022 provides a venue to discuss potential solutions to existing challenges and bring forward new ones, bringing together academic researchers, industry practitioners and regulators, working as a forum for exchanging knowledge and best practices related to the design and implementation of smart energy systems and technologies.

In this 5th edition **R&D Nester** presented one paper entitled "**FlexPlan: testing an innovative grid planning tool using European wide regional cases**". Its content was produced in the scope of R&D Nester project **FlexPlan** which aims at creating a new tool for optimizing transmission and distribution grid planning, considering the placement of flexibility elements as an alternative to traditional grid planning. This approach aims at helping to reduce overall power system costs i.e. infrastructure deployment and operation costs, the latter in terms of procurement of energy and system services.

In the paper, the general methodology used in the simulation toolchain was described, that consists of definition of the input data for simulations, the methodology for proposing a list of grid expansion candidates and solving the grid expansion problem. A set of simplifications has also been presented in order to reduce the required simulation time, which is a measure of computational effort, but to preserve a high level of accuracy and fidelity of the results. In order to demonstrate the robustness and applicability of the proposed solution, the preliminary results of four out of six Regional Cases were presented with description of the networks and details about existence of network congestions, which will be further processed to identify grid expansion candidates and solve the grid expansion problem for the multiple scenarios considered in **FlexPlan**."

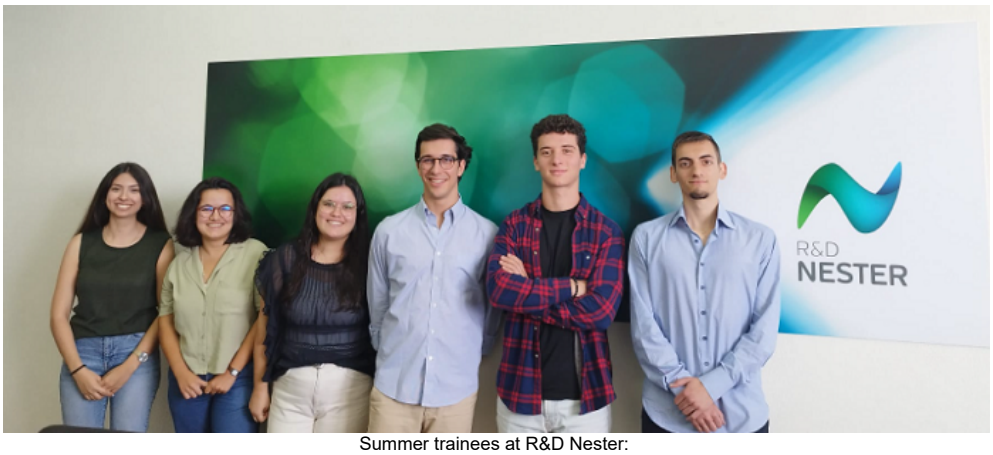
FlexPlan

For more information:

FLEXPLAN Project @ R&D Nester website
SEST 2022 Conference website
FLEXPLAN project website
FLEXPLAN Project @ LinkedIn

R&D NESTER SUMMER INTERNSHIPS IN RESEARCH, DEVELOPMENT AND INNOVATION

This Summer **R&D Nester** hosted 6 students who contributed in research, studies and projects.
They were from **Nova School of Science and Technology**, **Faculdade de Ciências da Universidade de Lisboa** and from **IST - Instituto Superior Técnico**.



Summer trainees at R&D Nester:
Sofia Lopes, Catarina Marcelino, Ana Catarina Araújo, Manuel Barros, Davide Silva e Rafael Rodrigues

These selected students were from courses as **Electrical Engineering and Computers** and **Energy and Environmental Engineering**:

Instituto Superior Técnico:

- DAVIDE SILVA (Internship area: renewable sources)
- MANUEL BARROS (Internship area: aggregation of distributed energy resources)
- RAFAEL RODRIGUES (Internship area: electric vehicles)

Nova School of Science and Technology

- ANA CATARINA ARAÚJO (Internship area: storage)
- SOFIA LOPES (Internship area: networks/planning)

Faculdade de Ciências da Universidade de Lisboa

- CATARINA MARCELINO (Internship area: consumption profiles)

This type of initiative allows these students to take advantage of their summer school break, thus enriching their knowledge with the reality of the sector dealing now with real projects.

In these period of collaboration with **R&D Nester**, these students end up acquiring more in-depth knowledge of the many concepts of the electricity and energy sector in general that until then only knew in theory.

This experience seeks to reconcile the theoretical and abstract knowledge these students acquired in their course, bridging the reality experienced in R&D Nester and the decisions that are associated to energy sector in general.

The context of R&D Nester is particularly suitable for this type of initiatives, as it provides them to work in Research, Development and Innovation area, often close to the student's study areas and already with a connection to applications in business life.

Trainees worked on themes such as **networks/planning grid**, **consumption**, **aggregation of distributed energy resources**, **electric vehicles**, **batteries** and **renewable sources**. The work developed by them was aligned with the current research needs of R&D Nester, being used in real projects that are in progress.

The collaboration with these students lasted between 5 to 7 weeks.



Trainees with their R&D Nester Coordinators

This was intended to be an enriching experience to remember and to boost the professional career of these 6 potential researchers and future professionals in the sector.

INTERCONNECTION CAPACITY CALCULATION METHODOLOGIES FOR THE EUROPEAN ELECTRICITY MARKET - R&D NESTER PRESENTS IN ICPST 2023

R&D Nester was represented in **2023 IEEE International Conference on Power Science and Technology (ICPST 2023)** with its participation in the Session entitled **"Power System Reliability Analysis & Power Supply System Planning and Dispatch"**.



Nuno Pinho da Silva, **Senior Researcher** of **R&D Nester**, leaded this session's final presentation with the paper entitled **"Analysis of the Interconnection Capacity Calculation Methodologies for the European Electricity Market"**.

This paper delves with the methodologies for the coordinated calculation of the available interconnection capacity for day-ahead and intraday energy markets. In particular, it investigates and compares the application of four different approaches for computing the generation/load shift keys, which are fundamental parameters underlying the coordinated capacity calculation methodologies in the internal European market for electricity.

This work was produced in the scope of the R&D Nester's project **MarCo - Research on Electricity Market Coupling**. This project studies the history, operation status, coordination relationship, existing problems and future development trends of spot markets in major European regions and in the internal European market for electricity. The project builds a security constrained market model and designs a simulation addressing the congestion management mechanisms in the internal European market for electricity.

The **ICPST 2023** conference was held in Kunming, Yunnan, China, last May, and also occurred in hybrid format.

This conference was sponsored by IEEE, Kunming University of Science and Technology (KUST), Science and Engineering Institute (SCIEI) and Test Department of Electric Power Dispatch Automation System and Equipment (Nanjing)-China Electric Power Research Institute.

For more information:

ICPST 2023 Conference website

MarCo Project @ R&D Nester website

R&D NESTER PRESENTED REGIONAL CASES RESULTS IN FLEXPLAN PROJECT'S FINAL WORKSHOP TO EUROPEAN STAKEHOLDERS

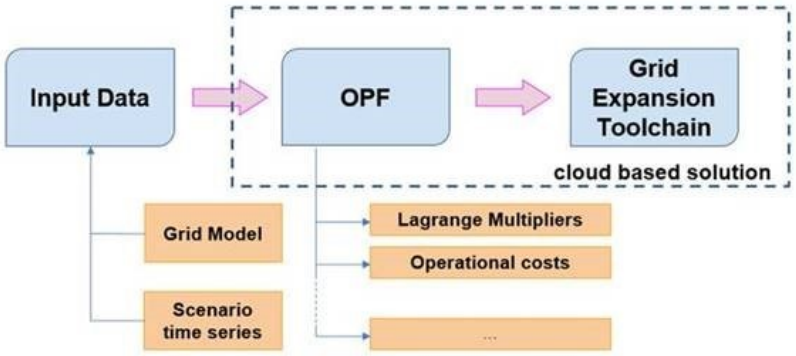
R&D Nester was present at the final workshop of the **FlexPlan project**, held in Brussels, Belgium, on the 14th of February 2023. The workshop intended to present the main results of the project to several European stakeholders, such as System Operators and Regulatory Entities.



The **FlexPlan** project aims at establishing a new grid planning methodology considering the opportunity to introduce new storage and flexibility resources in electricity transmission and distribution grids as an alternative to building new grid elements. The methodology is tested into 6 regional cases covering most parts of Europe, for realistic pan-European scenarios in 2030, 2040, and 2050.

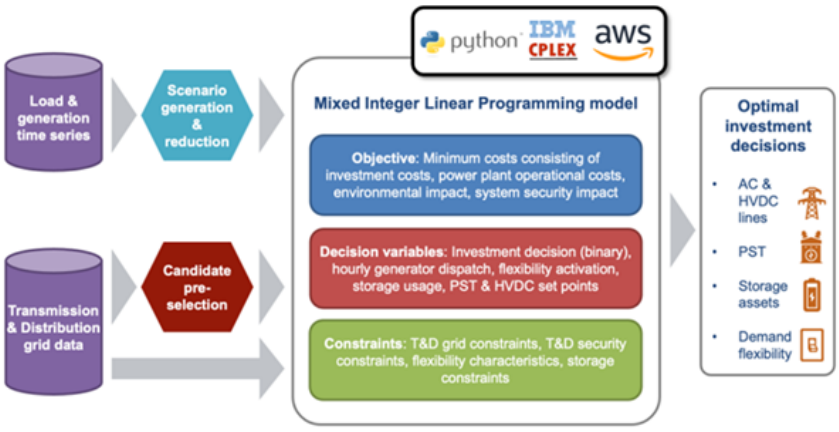
The FlexPlan methodology consists of three main steps, depicted below:

- Obtaining the initial input data by gathering information about grid models and scenario time series for each regional case
- Solving the optimal power flow (OPF) for the non-expanded grid, identifying the potentially profitable investments (candidates) to be processed into the grid expansion planning (GEP) tool, selecting among traditional grid reinforcements, storage units or flexible loads
- Solving the GEP problem by using the output from the OPF and candidates that were obtained in the previous step.



One of the main novelties introduced by the methodology is that, instead of analyzing a new investment at a time, it analyses all the pre-processed candidates at once, by determining the combination that minimizes the sum of capital and operational expenditures. Worth mentioning is that among the costs, environmental costs such as carbon footprint and air quality are considered as well, taking an important step forward with regard to state-of-the-art grid planning tools.

The optimization to be solved consists of a large Mixed Integer Linear Problem (MILP), which becomes numerically tractable due to the usage of decomposition techniques, i.e. Benders decomposition and decomposition between transmission and distribution planning. The MILP is solved by the FlexPlan planning tool, which was developed using state-of-art technologies and is capable to run complex simulations using stochastic optimization. The figure below gives an overview of the FlexPlan tool's architecture.



As mentioned above, the FlexPlan methodology and tool are validated on 6 European regional cases, being Iberian, France&BeNeLux, Italian, Balkan, Germany&Switzerland&Austria, and Nordic. **R&D Nester** is the leader of the related work package, named "**Regional cases and assessment of advantages over traditional planning**", and is hence responsible for the management and coordination of the testing activities of all regional cases.

During the final workshop, **Aleksandr Egorov**, a researcher from **R&D Nester**, pitched the presentation "**FlexPlan Regional Cases**", where he highlighted the results of the simulations of each regional case and extracted comparisons and conclusions. Among the main results, which will be further analyzed for the regulatory analysis within the project, it emerged that flexibility investments, i.e. storage units and flexible loads, are frequently approved by the tool, and may thus be considered in the future as both an alternative or a complementary option to traditional grid reinforcements, depending on how severe is the potential local grid congestion.



For more information:
FLEXPLAN Project @ R&D Nester website
FLEXPLAN project website

PRESIDENT OF CEPRI VISITED R&D NESTER

R&D Nester received a delegation from China Electric Power Research Institute (CEPRI), namely its **President, Mr. Gao KeLi**, and the **Director and Deputy Director of the International Cooperation Department, Mr. Li Bo and Ms. Ye Jin**.



CEPRI delegation also showed particular interest in visiting the **R&D Nester laboratory**.

This visit was part of R&D Nester Shareholders and Board Meetings. Since the pandemic, this was the first physical meeting of R&D Nester Corporate Bodies.

China Electric Power Research Institute (CEPRI) is a comprehensive and multi-disciplinary research institute affiliated to the **State Grid Corporation of China (SGCC)**.

Since 1951, CEPRI is devoted to R&D, testing and inspection, and technical standard formulation that are of fundamental and universal significance to power grids. It has the task of coordinating efforts of the provincial electric power research institutes under SGCC to build an integrated technical support system. CEPRI is also active in a broad variety of research areas relevant to electric science and business, including power generation, transmission, and distribution, power supply and utilization, electric project design, construction, commissioning, operation, monitoring and maintenance and renewable energy, new materials, energy conversion, information and communication technology, etc.

For **R&D Nester** it was an honor to receive this distinguished delegation.





R&D NESTER IS THE PARTNER SELECTED BY OPAL-RT TO SHOWCASE ITS MOST RECENT SUCCESS STORY WITH THE TITLE “HIL SIMULATION FOR THE SUBSTATIONS OF THE FUTURE”

In this Success Story it's possible to discover how R&D Nester is shaping the future of power systems simulation and renewable energy management with the help of OPAL-RT's real-time solutions. R&D Nester's Real-Time Power Systems Simulator (RTPSS) Laboratory is providing a unique research and simulation infrastructure to analyze the behavior of different components of power systems.



OPAL-RT is a worldwide leading company on Real-time Simulation systems. These systems have the potential to reduce the costs and delays for complex mechanical and electrical system design, prototyping and testing, by providing high-performance simulation systems that are open and easy-to-use, utilizing commercial technology optimized for parallel computing, with the ultimate goal of making

real-time simulation efficient, precise and accessible to all.

We invite you to learn about some examples of what R&D NESTER has been doing with OPAL-RT Real-time Simulator towards the Substations of the Future.

Link OPAL-RT website: https://www.opal-rt.com/resource-center/document/?resource=Mkt_0027592

Extra: Additional info on Hypersim Users (with reference to R&D NESTER)

HYPERSIM® Customers

https://blob.opal-rt.com/medias/L00161_0997.pdf

TECHNICAL INFORMATION

SYSTEM-WIDE NODAL CAPACITY ALLOCATION APPLIED TO A SPANISH DISTRIBUTION NETWORK

In the context of the H2020 INTERPRETER, R&D Nester developed a tool that could provide technical maximums for nodal power injection in a distribution grid. The Nodal Capacity (NCA) Tool leverages on the power of Genetic Algorithms (GA) to solve non-convex optimization problems to give DSOs a sense on much power can be injected on each node, without compromising and grid safety limits.

The proposed method follows a three-step approach, including a preliminary stage where a non-simultaneous analysis of the nodal capacity is addressed (Fig. 1), a second stage that inputs the results from the latter into a grid-level simultaneous analysis for all nodes (Fig. 2), and finally a step for risk analysis to quantify the system-wide margin each node has to increase the capacity for new power injection.

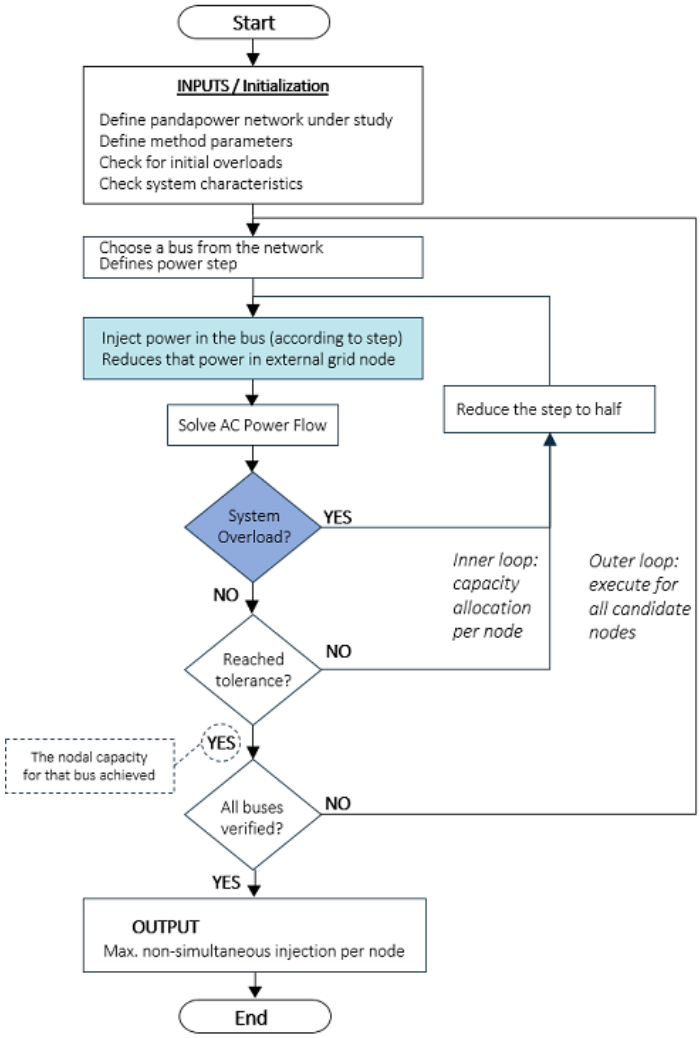


Figure 1: Non-simultaneous NCA flowchart

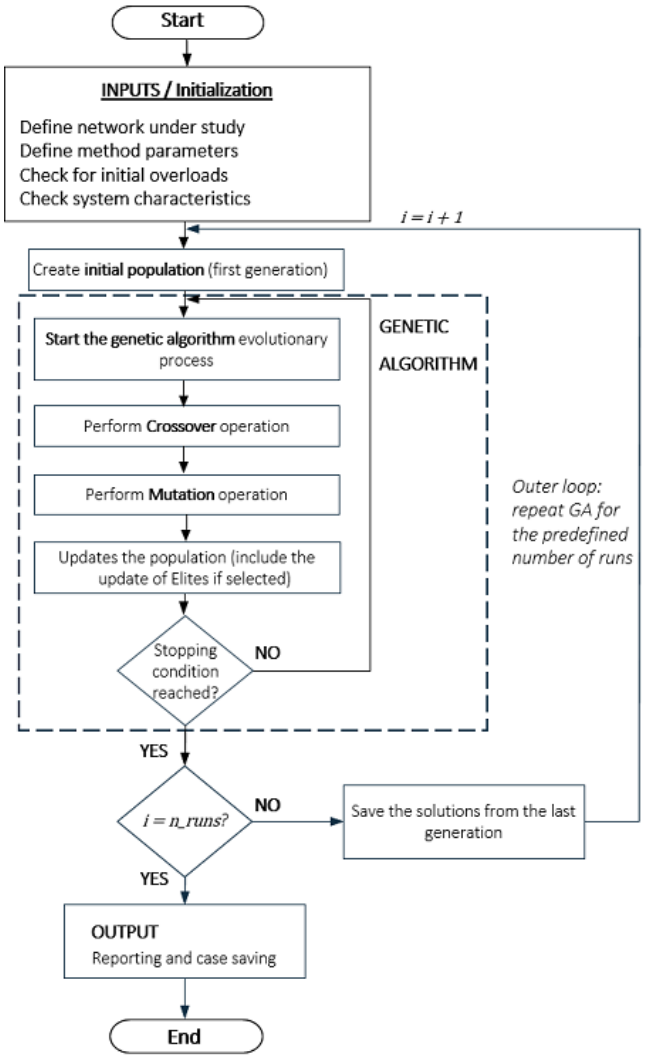


Figure 2: Simultaneous NCA flowchart

The application of the NCA method to the network and scenarios considered 5 runs of the simultaneous step, using a population of 200 chromosomes evolving over 150 generation. As previously mentioned in the methodology section, instead of providing only the best solution, the NCA generated a total of 276 well-fitted solutions, all different combinations of nodal injections to maximize the total nodal power injection. In order to evaluate the fitness proximity of the solutions, a statistical analysis of the 276 solutions' fitness for the case under analysis is presented in Fig. 3.

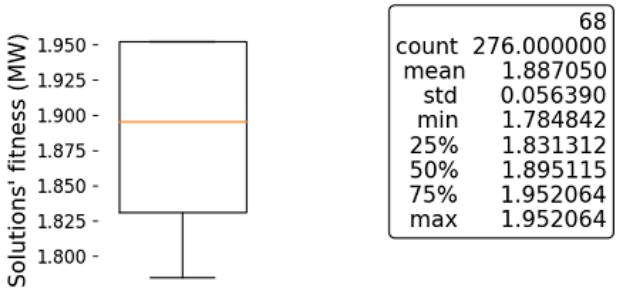


Figure 3: Statistical analysis of all the solutions' fitness

The most significant samples of fitness values - sitting within the first and third quartiles (Q1 and Q3), respectively between 25 and 75% of all data analysed - is narrowed to a range of around 100 kW (i.e., total new injected power for all candidate nodes). This means that, although the analysis considers solutions with variable fitness, all are valid and may be considered.

The main output of the method can be seen in Fig. 4. It shows the new active power capacity margin available in each of the selected/candidate nodes for the different possible solutions, displayed in a collection of boxplots where the statistical distribution of the available margins can be represented. As

expected, the margin for new power injection varies along the different nodes - for the scenario under analysis, and within the provided solutions, some nodes allow much higher power injection than others. The heterogeneous electrical location of the candidate buses and the respective differences in the lines' dimensioning across the network provide, in this case, a clear view of the importance of the method. Additionally, this variability is also expected due to the stochastic nature of the algorithm, based on random events, that privileges the increase of power in certain nodes in a given run, and others for other runs.

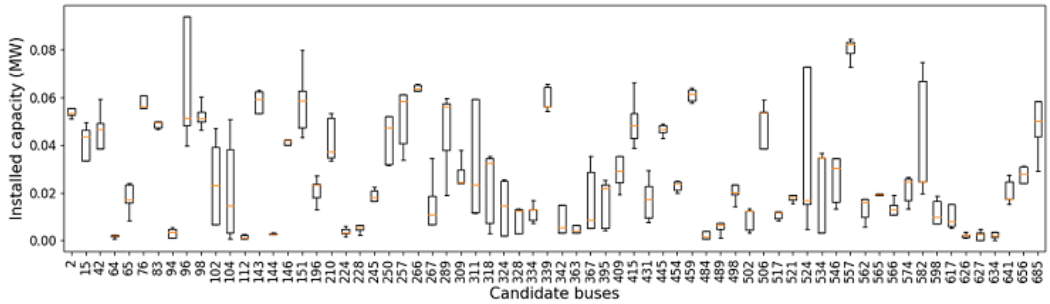


Figure 4: Percentile-based plot presentation of NCA tool solution, with the margin for new power injection of every candidate node in relation to the other

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LITERATURE REVIEW

WORLD ENERGY COUNCIL - World Energy Trilemma Index | 2022 - November 2022

The World Energy Trilemma is in its 12th year of publication amidst a time of unprecedented energy shocks and multiple crises that continue to cause disruptions to energy systems. The interaction of these shocks and crises has a cascading impact that affect energy security, energy affordability and sustainability issues including climate change across regions.

The World Energy Council is the principal impartial network of energy leaders and practitioners promoting an affordable, stable and environmentally sensitive energy system for the greatest benefit of all.

The World Energy Council's definition of energy sustainability is based on three core dimensions: Energy Security, Energy Equity, and Environmental Sustainability of Energy Systems. Balancing these three goals constitutes a ‘Trilemma' and balanced systems enable prosperity and competitiveness of individual countries.

The World Energy Trilemma Index has been prepared annually since 2010 by the World Energy Council in partnership with global consultancy Oliver Wyman, along with Marsh & McLennan Advantage of its parent Marsh & McLennan Companies. It presents a comparative ranking of 127 countries' energy systems. It provides an assessment of a country's energy system performance, reflecting balance and robustness in the three Trilemma dimensions.



Link for Publication

SUMMARY REPORT | City Level Clean and Just Energy Transition - January 2023

In May 2022, the Aberdeen Clean and Just Energy Transition project was established in collaboration with the World Energy Council, BP (one of the world's largest energy companies) and Aberdeen City Council (ACC).

This partnership was set up with the goal of discovering and building upon previous work relating to clean and just energy transition, aligned with the transition principles of the Scottish Government.

Contributing to the knowledge base of energy transition was deemed an important step in extending the ongoing work in the city of Aberdeen. The scope of the project is:

1. to provide a knowledge base of outcomes and key learnings around issues of a clean and just energy transition through the rapid evidence research outputs and,
2. to explore citizens' perspectives of the clean and just energy transition to inform further action plans into additional work on the clean and just energy transition in Aberdeen, Scotland.

This report includes the key highlights from task 1, with outcomes of a rapid evidence review on how to achieve an inclusive and just energy transition in energy cities. It also some insights on community engagement from the outcomes of task 2, which explored Aberdeen citizens' perspectives of the clean and just energy transition.



Link for Publication

WORLD ENERGY COUNCIL - World Energy Pulse April 2023 - May 2023

The World Energy Pulse, the World Energy Council's surveys of global energy leaders from nearly 80 countries, provides snapshots of current attitudes and trends felt across the energy ecosystem and delivers global and regional perspectives of crises implications and transformational actions.

Taken at regular intervals, the Pulse equips decision makers and other energy stakeholders by:

1. enabling real-time decision-making amidst fast-changing situations

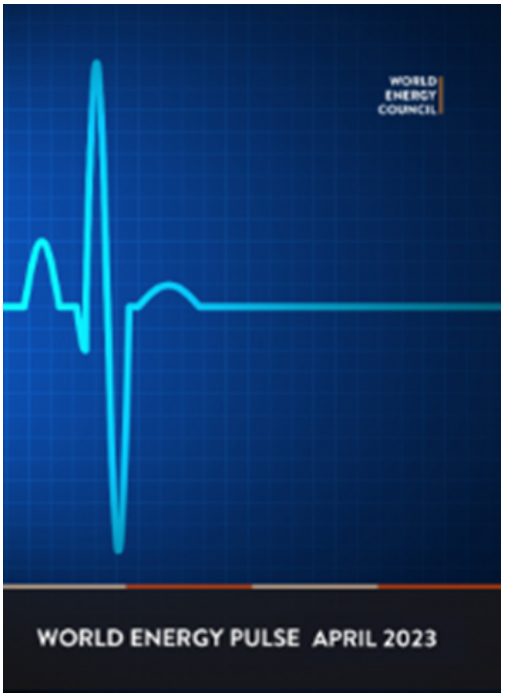
2. leveraging new and timely insights harvested across the world energy community

3. informing, catalysing and supporting more effective collaborative actions in energy across the globe

As the energy sector continues to be impacted by the aftershocks from COVID-19, the ongoing war in Ukraine, and an international scramble to respond to President Biden's Inflation Reduction Act, the April 2023 World Energy Pulse reveals that national security interests and the green technology arms race are considered the greatest obstacles to energy transition progress.

- 59% of respondents agree that energy independence is critical to securing their countries' climate-energy-security agendas. However, this 'me-first' sentiment is challenged with the overwhelming (84%) acceptance that energy interdependence is the new global reality.
- 86% of respondents said that effectively managing choices and trade-offs using the World Energy Trilemma framework - energy security, affordability, and sustainability - is the best approach to avoiding disorderly transitions and addressing the new and emerging challenges of climate resilient energy for sustainable development.
- 64% of respondents continue to be concerned by the pace and progress of energy transitions, nearly double those who expressed similar concerns in the Council's Pulse survey last year.

- Leaders are particularly concerned that insufficient action is being driven from the bottom up, with 35% of respondents stating that individuals and communities should be empowered to lead transformations. 43% see challenges around 'affordability and modern energy access' as the most concerning aspects of ensuring a fair energy system.



Link for Publication

EASE Activity Report 2022 - February 2023

The European Association for Storage of Energy (EASE) located in Brussels, Belgium, is the leading member-supported association representing organisations active across the entire energy storage value chain. EASE supports the deployment of energy storage to support the cost-effective transition to a resilient, climate-neutral, and secure energy system.

EASE was established in 2011 and represents approximately 60 members, including utilities, technology suppliers, research institutes, distribution system operators, and transmission system operators.

Last year was a significant one for EASE and for the Energy Storage sector.

As soon as the curtains closed on 2022, it was clear that it marked a pivotal year for Europe, sending shock waves across the globe. Safeguarding our Energy Security has become an urgent priority, underscored by geopolitical instability and the increasing pace of the climate crisis.

In this rapidly evolving landscape, Energy Storage is key to achieve an independent and secure access to energy, whilst paving the way for a carbon neutral economy. As we look back on this past year, we can confidently state that we have gained substantial ground on this issue. At EASE, we are determined to continue to forge this path towards a promising future.

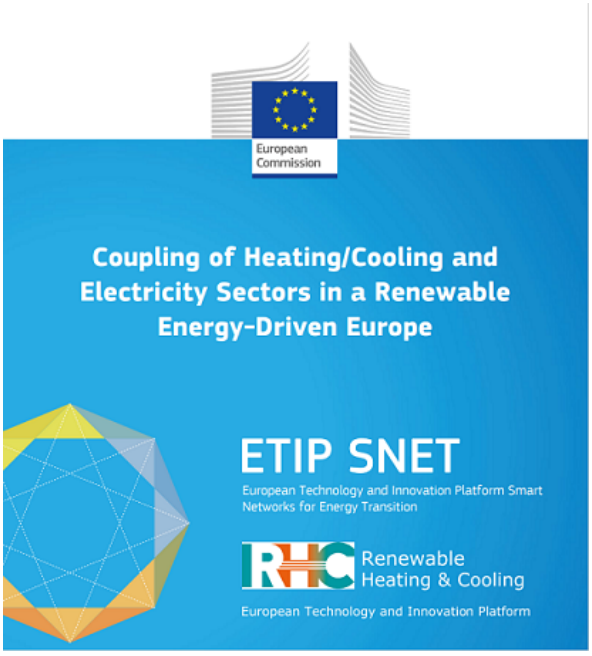


Link for Publication

R&D NESTER CONTRIBUTES TO THE DEFINITION OF GUIDELINES FOR THE COUPLING OF HEATING&COOLING AND ELECTRICITY SECTORS IN EUROPE



The White Paper *"Coupling of Heating/Cooling and Electricity Sectors in a Renewable Energy-Driven Europe"* focuses on the implications of coupling the electricity, heating and cooling vectors as a vital part of efficiently decarbonising the European energy sector.



This document resulted from the cooperation of several experts from two European Technology & Innovation Platforms (ETIPs), namely ETIP Renewable Heat and Cooling (RHC) and ETIP Smart Networks for Energy Transition (SNET) in which R&D NESTER has several experts involved in several working groups. ETIPs have been created by the European Commission in the framework of the new Integrated Roadmap Strategic Energy Technology Plan (SET Plan) by bringing together a multitude of stakeholders and experts from the energy sector.



This white paper was released on past 25th of November and includes the contributions from **R&D NESTER**'s researcher Ricardo Pastor, which collaborates with ETIP-SNET WG2 (Storage technologies and system flexibilities).

More information:

White Paper

ETIP RHC

ETIP SNET

EVENTS

25 -25 Sep 2023

COPENHAGEN, DENMARK

7TH E-MOBILITY POWER SYSTEM INTEGRATION SYMPOSIUM - RENEWABLE ENERGY GRID INTEGRATION WEEK

26 -29 Sep 2023

COPENHAGEN, DENMARK

RENEWABLE ENERGY GRID INTEGRATION WEEK - E-MOBILITY | WIND & SOLAR

9 -13 Oct 2023

KANSAS CITY, MO

THE GRID OF THE FUTURE SYMPOSIUM, SPONSORED BY THE CIGRE US NATIONAL

12 -13 Oct 2023

ABERDEEN, SCOTLAND UK

THE WORLD ENERGY COUNCIL'S EXECUTIVE ASSEMBLY AND ENERGY TRILEMMA SUMMIT

26 -27 Oct 2023

LISBON, PORTUGAL

CONIBEN 2023

E-MOBILITY | WIND & SOLAR

25 -26 Oct 2023

LISBON, PORTUGAL

EVEX 2023

4 -7 Dec 2023

ROTTERDAM, THE NETHERLANDS

26TH WORLD ENERGY CONGRESS - REDESIGNING ENERGY FOR PEOPLE AND PLANET

23 -26 Oct 2023

GRENOBE, FRANCE

IEEE PES ISGT EUROPE 2023 (ISGT EUROPE 2023)

13 -16 Nov 2023

LISBON, PORTUGAL

OPAL-RT'S 15TH ANNUAL CONFERENCE ON REAL-TIME SIMULATION

25 -30 Aug 2024

PARIS, FRANCE

CIGRÉ SESSION

QUIZ

1) WHICH GENERATION TECHNOLOGY PRODUCED THE MOST ENERGY IN PORTUGAL IN 2022?

- a) Hydro
- b) Wind
- c) Gas
- d) Nuclear

2) WHICH GENERATION TECHNOLOGY HAS THE MOST INSTALLED CAPACITY IN PORTUGAL AS OF 2022?

- a) Hydro
- b) Wind
- c) Gas
- d) Nuclear

3) WHICH WAS THE LAST YEAR IN WHICH PORTUGAL EXPORTED ELECTRICAL ENERGY?

- a) 2016
- b) 2018
- c) 2020
- d) 2022

4) IN THE LAST 10 YEARS (SINCE 2013, INCLUDING IT) WHICH WAS THE ONLY YEAR THAT SAW A REDUCTION IN INSTALLED CAPACITY IN PORTUGAL?

- a) 2013
- b) 2017
- c) 2020
- c) 2021

5) HOW MUCH ENERGY, IN TWH, WAS PRODUCED IN PORTUGAL IN 2022, USING COAL?

- a) 0
- b) 0.694
- c) 2.491
- d) 16.6

Correct answers will be provided to you soon.
If you have problems answering this quiz, click here to answer this via browser.

1. Answer: b) Wind
2. Answer: a) Hydro
3. Answer: b) 2018
4. Answer: c) 2021
5. Answer: a) 0

LINKS

ON RESEARCH, DEVELOPMENT AND INNOVATION

Portugal

- Portugal 2020

OTHER ENTITIES

Portugal

- Laboratório Nacional de Energia e Geologia (LNEG)

- Portal da Inovação
- Agência Nacional de Inovação (ANI)
- COTEC Portugal
- Portugal in Europe Research and Innovation Network (PERIN)
- Agência para o Desenvolvimento e Coesão (AdC)
- Direção-Geral de Estatísticas da Educação e Ciência (DGEEC)
- Associação de Energias Renováveis (APREN)
- Associação Portuguesa da Economia da Energia (APE)
- Portugal Energia
- Portal de Ciência e Tecnologia | Fundação para a Ciência e a Tecnologia (FCT)
- ERSE - Entidade Reguladora dos Serviços Energéticos
- DGGE - Direção-Geral de Energia e Geologia

Europe

- BRIDGE (H2020)
- European Energy Research Alliance (EERA)
- ETIP SNET - European Technology and Innovation Platform Smart Networks for Energy Transition
- Horizon 2020
- Horizon Europe
- BlueInvest
- EIT InnoEnergy
- Eurostat - Science, Technology and Innovation
- Funding, Tenders | European Commission
- Research and Innovation | European Commission
- Energy, Climate Change, Environment | European Commission

Europe

- European Network of Transmission System Operators for Electricity (ENTSO-E)
- The European Wind Energy Association (EWEA)
- The Alliance for the Internet of Things Innovation (AIOTI)
- JRC Publications - Joint Research Centre - Smart Electricity and Interoperability
- The European Commission's Priorities
- A Europe fit for the digital age | European Commission
- European Climate, Infrastructure and Environment Executive Agency (CINEA | ex-INEA)
- EUASP - The European Union Agency for the Space Programme
- ESA - The European Space Agency

Rest of World

- China Electric Power Research Institute (CEPRI)
- Mission Innovation
- Innovation – Department of Energy (USA)
- NREL – National Renewable Energy Laboratory
- EPRI- Electric Power Research Institute
- EU-GCC Clean Energy Technology Network

Rest of World

- CIGRE - International Council on Large Electric Systems
- CTCN - Climate Technology Centre and Network
- GEIDCO - Global Energy Interconnection Development and Cooperation Organization
- Energy Web
- World Intellectual Property Organization (WIPO)
- International Energy Agency (IEA)
- International Electrotechnical Commission (IEC)

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