R&D NESTER

22 NL dez 2021

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EDITORIAL

Dear Reader,

There is so much going on in the Energy World and the so called Energy Transition, that it is difficult for an energy field professional or enthusiast not to find at least on topic in this Newsletter to which to relate to.

This goes from the global level of modular grid management solutions for design, planning, operation and maintenance, that we are addressing in the H2020 INTERPRETER project with its 10 software application being developed, to the detailed world of models of control for Power System Stabilizers that we are developing together with our partners in H2020 Project Flexitranstore.

It goes also from application of Artificial Intelligence and Machine Learning technologies to the energy space, such as the one with which R&D Nester obtained a 3rd place in an IEEE international competition, to the increase use of digitalization and communication standards such as those related to Power Line Communications that we presented in our recent communications in conferences and journals.

It goes finally from solar forecast and the challenge of clouds detection to the valuation of storage services in the market and to the contributions of Energy Communities to the much needed flexibility of the power system.

All of these you can find detailed below.

Finally, if you are up to a challenge, you can see how you score on battery storage trivia in our popular Quiz section at the end of this Newsletter.

Enjoy your reading!

Sincerely,

Nuno de Souza e Silva

Managing Director

HIGHLIGHTS

R&D NESTER DEVELOPS CONTROL MODEL FOR FLEXIBLE SYNCHRONOUS GENERATION WITH EUROPEAN PARTNERS



Within the scope of the activities of the European Project FLEXITRANSTORE ("An Integrated Platform for Increased FLEXIbility in smart TRANSmission grids with STORage Entities and large penetration of Renewable Energy Sources") and the demonstrator associated with activity 12.3 (Implementation and demonstration in a hybrid environment), the report associated with this task was successfully delivered to the European Commission at the beginning of May.

This report addresses a key phase of the WP12 (Work Package), which encompasses the activities of demonstrator 8 - "Advanced Control for flexible synchronous generation", where the developed system was tested in a real-time simulation environment. This WP addresses the demonstration of innovative models of control and tuning of the Power System Stabilizer (PSS) of generators in order to improve the damping capacity of low frequency oscillations (LFOs), strengthening the network as it increases generation flexibility.

In this work, R&D NESTER contributed to the development and implementation of a model based on the physics of the phenomenon (Grey Box Model) to predict the behavior of the electrical network in various operating scenarios, focusing on the events that originate this type of low frequency phenomena (LFOs).

The model developed by R&D NESTER is part of an integrated system, target of demonstration, which allows to adjust the parameters of the PSS in real time, optimizing the response of the generation, thus increasing the resilience and flexibility of the electrical system. The demonstration in real environment of this system is planned to start in the next months in a cogeneration plant in Bulgaria.

This project, in which R&D NESTER participates, is financed through Grant Agreement N. 774407 of the European Research and Innovation Program H2020.

Flexitranstore Project (R&D Nester website)

Flexitranstore Project Website

FIRST RESULTS OF H2020 INTERPRETER PROJECT ON TOOLS FOR ELECTRICITY GRID PLANNING



R&D Nester partakes in the project INTERPRETER - "Research on advanced tools and technological development (RIA) - Interoperable tools for an efficient management and effective planning of the electricity grid", submitted to the European Commission's H2020 program and approved.

INTERPRETER main objective is the implementation of a modular grid management solution consisting of a set of 10 software applications for an optimal design, planning, operation and maintenance of the electricity grid - with a special focus on the distribution network - that will be offered to grid operators through an open-source interoperable platform. These tools will support DSOs and TSOs to move from a traditional grid management approach to an active system management approach, considering the rapid deployment of distributed energy resources as well as growing environmental concerns.

On May 2021 was released the first issue of INTERPRETER's newsletter.

This project started in October 2019, and after 18 months of implementation, its partners share this issue of its bi-annual newsletter where you can find the latest developments and details.

INTERPRETER Website

INTERPRETER Project (R&D Nester website)

R&D NESTER WINS 3RD PLACE AT INTERNATIONAL IEEE COMPETITION ON ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING



R&D Nester participated in **IEEE ODS competition on building energy consumption forecasting,** with its AI.Forecasting tool, reaching **3rd place** among 42 participants.

This competition is organized by the IEEE Power & Energy Society Technical Committee on Analytic Methods for Power Systems (IEEE PES AMPS) / Intelligent Systems Subcommittee (ISS). The main objective of this IEEE competition is bringing together the most recent advances in building energy consumption forecasting methods.

Energy consumption forecasting is crucial in current and future power and energy systems. With the increasing penetration of renewable energy sources, with high associated uncertainty due to the dependence on natural conditions, such as wind speed or solar intensity, the need to balance the fluctuation of generation with the flexibility from the consumer side increases considerably. In this way, significant work has been done on the development of energy consumption forecasting methods, able to deal with different forecasting circumstances, e.g., the prediction time horizon, the available data, the frequency of data, or even the quality of data measurements. The main conclusion is that different methods are more suitable for different prediction circumstances, and it is not clear that a certain method can outperform all others in all situations.

Hence, R&D Nester developed the AI.Forecasting tool, an architecture of AI and machine learning methods that enables the automatic learning of energy forecasting models specific for each application.

The developed ensemble solution is a combination of different ML methods that perform different non-linear transformations to the same data. The individual methods composing the ensemble are Support vector machines, Extreme gradient boosting and Deep learning using long short-term memory networks. This tool was developed under the scope of the GIFT project, an innovation project funded by the European Commission that aims at decarbonizing the European islands through the application of multiple innovative solutions, such as a virtual power system, energy management systems for harbors, factories and homes, better prediction of supply and demand, visualisation through a GIS platform, as well as innovative storage systems, allowing synergy between electrical, heating and transportation networks.

The competition was held during a full business week (14-18 June, 2021). Each day of this week participants were asked to provide their consumption forecasts for the following day.

Immediately after the deadline for submission, the real data from the respective day were provided, so that it could be used to generate the next output.

In order to build and refine the forecasting models, a full year of historical data was provided by mid-April.

Two weeks before the competition week, the following 40 days of historical data was provided - referring to the period immediately before the days to be forecasted.

Finally, during the competition week, the data that refers to the last day was provided on a daily basis.

Final results of this competition were revealed on July 27th, during the IEEE Power & Energy Society General Meeting that was held in Washington, DC, were Ângelo Casaleiro, represented R&D Nester in this competition, presenting this AI.Forecasting Tool.

R&D Nester's final presentation was very well received, generating interest, several comments and questions from the audience and other participants. This generated a very interesting final debate on the methodology of this tool developed by R&D Nester under the scope of the GIFT project, an innovation project funded by the European Commission that aims at decarbonizing the European islands through the application of multiple innovative solutions, such as a virtual power system, energy management systems for harbors, factories and homes, better prediction of supply and demand, visualization through a GIS platform, as well as innovative storage systems, allowing synergy between electrical, heating and transportation networks.

Improved forecasting is key to contribute to an efficient and reliable energy system in the energy transition process.

R&D Nester - Creating a Smart Energy Future!

For more information:

IEEE ODS Competition website

GIFT Project

2021 IEEE PES GM Conference website

R&D NESTER PRESENTATION ON STORAGE VALUE AND PUBLICATION ON SOLAR FORECAST, IN POWERTECH 2021



R&D Nester was represented in this year's edition of the PowerTech Conference that was held in Madrid, Spain at Comillas University with a simultaneous virtual format.

PowerTech is the anchor conference of IEEE PES in Europe. It provides a forum for engineers and scientists in electric power and energy systems to present their work and share information in this area of growing interest and importance in the industry and economy worldwide.

This year edition lemma was "Power for the Sustainable Development Goals (SDGs)" which emphasizes the relevance of renewable and digitized power systems in achieving some of the main SDGs: fighting against climate change, affordable and clean energy for all, clean water and sanitation, and sustainable cities and communities, among others. The electrification of mobility, climatization of buildings, and industrial uses are the main drivers for achieving sustainable and CO2-neutral economies by 2050. This conference brings the opportunity to share and discuss challenges, technological solutions, and business and regulatory models for a more sustainable future.

In this 14th edition R&D Nester was the author in one article that was presented entitled "Identification of clouds using a all-sky imager". Researcher João Esteves presented this paper whose content was produced in the scope of R&D Nester project UltraFOR that aims the "Improvement of the very short-term forecast for solar PV", investigating cloud recognition methods based on all sky imager data and research about cloud height calculation based on two all sky imagers.

Another R&D Nester presentation entitled "Energy Storage: from value to markets" was made on the 4th day of this conference by researcher Ricardo Pastor in a special session dedicated to the role of Energy Storage in Power Systems. Its content was produced based on the experience gathered in several projects in which R&D Nester participates such as "Energy Storage Planning", "Renewable Integration Tools" or "OSMOSE". The invitation for this R&D Nester presentation comes within the scope of R&D Nester involvement in Working Group 2 "Storage Technologies and Sector Interfaces" of ETIP-SNET. This WG2 addresses the technological and market developments related to energy storage solutions to ensure the required level of flexibility for the transmission and distribution of electricity.

For more information:

"Energy Storage Planning" R&D Nester Project

"Renewable Integration Tools" R&D Nester Project

UltraFOR R&D Nester Project

ETIP-SNET WG2 "Storage Technologies and Sector Interfaces"

For more information regarding this event: PowerTech 2021 website

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R&D NESTER PRESENT AT ICPICS 2021, WITH ONE PAPER ON POWER LINE COMMUNICATIONS STANDARD



From 29-31 July, R&D Nester was represented in 2021 edition of **IEEE International Conference on Power, Intelligent Computing and Systems**, held in Shenyang, China. This is an international conference sponsored by IEEE and whose papers will be published in the official database of this worldwide reference institution in engineering (IEEExplore).

In this first edition of ICPICS, R&D Nester was the author in one paper that was presented, entitled **"Assessing the Performance of the IEEE 1901.1 Power Line Communication Standard using OMNeT++"**. Its content was produced in the scope of R&D Nester project **HighSpeedCarrier**.

This R&D Nester project aims to investigate on the applicability, interoperability and compliance testing devices that implement the IEEE 1901.1 Power Line Carrier Standard.

The work presented in this paper reports the creation of a simulation environment, using a software for simulation of communication networks, where the main characteristics of IEEE 1901.1 can be assessed and compared with other power line carrier communication standards used in large scale, as PRIME.

The simulation model created includes the definition and simulation of the physical (PHY) and media access control (MAC) layers, allowing to test the characteristics of the IEEE1901.1 and evaluating its performance, namely the achieved data rates and network stability indexes for networks implementing this standard.

ICPICS 2021 Conference Website

R&D Nester Project "HighSpeedCarrier"

R&D NESTER WITH TWO PAPERS PUBLISHED IN IOP SCIENCE JOURNAL, RELATED TO CONFORMANCE TESTING AND ELECTROMAGNETIC COMPATIBILITY OF POWER LINE CARRIER DEVICES



Last month of May R&D NESTER presented 2 papers at the Fourth International Conference on Mechanical, Electric and Industrial Engineering (MEIE2021) that was held in Kunming, China.

All papers submitted to MEIE2021 were peer-reviewed and the papers submitted by R&D NESTER were selected for further publishing in a special edition of the IOPscience Journal of Physics: Conference Series, Volume 1983, on August 12. IOP (Institute of Physics) is a main publisher of scientific journals and this particular journal publishes open access papers from selected conferences in order to further disseminate the technical and innovative work developed and presented in these events.

R&D Nester published papers are entitled "Implementation and testing of a conformance platform for IEEE 1901.1 Power Line Communication Standard" and "IEEE 1901.1 Power Line Communication electromagnetic emission study". Both papers were produced in the scope of HighSpeedCarrier Project, a project currently in development in R&D NESTER.

The main goal of HighSpeedCarrier project is to develop and validate solutions related to IEEE 1901.1, a new power line carrier communication standard recently released by IEEE. Solutions developed in the scope of the project include software solutions for simulation of IEEE 1901.1 related devices and communication networks, a platform for testing electromagnetic compatibility of IEEE 1901.1 compliant devices and a platform for testing the standard compliance from devices. The project is developed in cooperation with China Electric Power Research Institute (CEPRI).

The work reported in the two publications is related to the development and validation of hardware and software platforms for testing the conformance devices that implement IEEE 1901.1 and measuring electromagnetic emission levels.

All details about the two publications and the HighSpeedCarrier project can be accessed in the links below:

IOPscience Volume 1983

ICMEIE 2021 website

R&D Nester Project "HighSpeedCarrier"

R&D NESTER IN ROUNDTABLE ON ENERGY SECURITY IN THE POST-PANDEMIC WORLD



On **September 14th R&D Nester** was represented in the **6th Scientific Conference "Energy Security - Pillars and Development Perspective"**.



This conference was held between September 13th and 14th at the Rzeszów University of Technology, in Rzeszów, Poland.

The Ignacy Lukasiewicz Energy Policy Institue's (EPI) is the coordinator of this event, which mission is to support and promote activities related to the development of civic society, and to popularize science and knowledge concerning energy policy.

The co-organisers of this conference are the Department of Economics of the Faculty of Management of the I. Łukasiewicz Rzeszów University of Technology and the Student Scientific Association "Eurointegration".

This conference is **sponsored by NATO's Public Diplomacy Division**.

The aim of the event is to contribute to the scientific and expert discussion on energy policy, energy security and the energy sector in its broadest sense. The idea is to build an instrument supporting the development of these areas of knowledge, by providing a platform for discussion with the participation of scientists, experts, representatives of public administration, energy companies, non-governmental organisations, business journalists and students.

In total, **the previous five editions of the Conference were attended by over 1 thousand participants** (representing 50 scientific centres), about 4 thousand students and nearly 140 thousand virtual attendees.

This **6th edition's theme was focuses on the energy transition**, while continuing the scientific discussions undertaken in previous editions of the event. Key areas to be covered include: nuclear energy, hydrogen, quantum materials, offshore wind energy, threats in cyberspace, cooperation in cyber security, energy storage, influence operations in the context of Russian energy projects, energy security of the countries of NATO's eastern flank in the context of the policy of the Russian Federation, energy infrastructure in the Baltic Sea, new technologies in the security of energy sector facilities and in civil aviation, and energy security in a post-pandemic world.

R&D Nester was represented in a roundtable panel entitled **"Energy security in the post-pandemic world"**, where Nuno Souza e Silva, Managing Director of R&D Nester, along with 3 other speakers, commented and express their views on **how pandemic has affected and changed energy markets and electricity as well**, and **how post-pandemic period should be faced in these areas**.

For more information: Conference website

R&D NESTER AS SPEAKER IN WEBINAR ON NETWORK ANCILLARY SERVICES AND THE FUTURE ROLE OF ENERGY COMMUNITIES



On 22 September R&D Nester presented an overview on ancillary services at the webinar about **"Network Ancillary Services and the future role of Energy Communities"**, organized by **FleXunity** project.

FleXunity is a European Union H2020 funded project under the program Fast Track to Innovation. R&D Nester presentation is entitled **"Ancillary Services overview"** and it was produced in the scope of R&D Nester participation in this Project. The presentation will characterize the ancillary services at the electric transmission grid and share the project's conclusions on what ancillary services are best suited to improve the integration of energy communities in the European electricity market.



The objective of FleXunity project is to deploy novel services for retailers and aggregators, enhanced by Virtual Power Plant (VPP) technology empowered with AI algorithms focused on minimizing the cost of energy (bought in the wholesale market) and optimizing the use of distributed renewables from the utility or community portfolio.

The proposed energy community approach will promote active participation of end-users (community members) valuating their flexibility and energy sharing actions, which will be supported by secure transaction mechanisms with technologies such as blockchain to validate energy transactions. A tariff structure optimisation will be design for the Energy Community to be able to meet the needs of the system operator by aggregating the flexibility to participate in balancing and ancillary services markets as a Balancing Service Provider (BSPs).

The proposed services will be demonstrated in two pilots with very different market conditions: in the U.K. (mature market open to the use of demand-side flexibility) and Iberian energy market (in transformation - opening to use of flexibility from the demand side).

Link for event

FleXunity Project (R&D Nester)

TECHNICAL INFORMATION

Cloud Identification using Image Processing Techniques

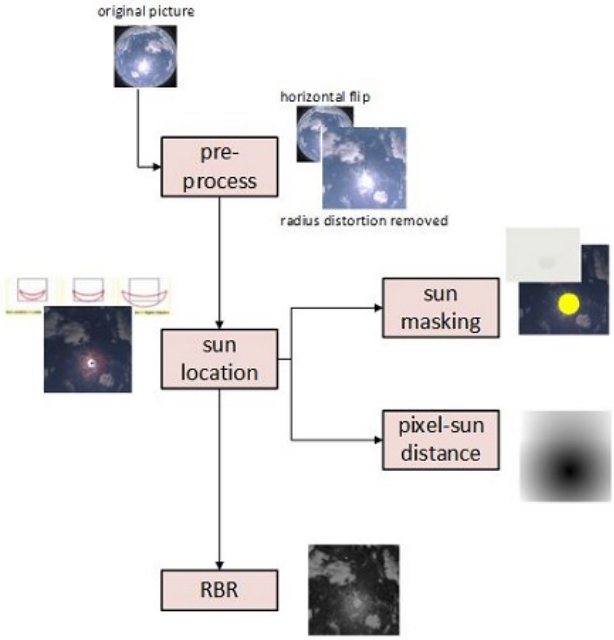
In the sequence of studies using all-sky imager (ASI), R&D NESTER during 2020 developed an image processing methodology that can be applied to ASI in order to identify clouds in the sky and provide a cloud index.

In this context, three cloud detection and cloud index formulation were developed:

- Cloud Index Method 1, which uses a single threshold value to distinguish cloud pixels from sky pixels;
- Cloud Index Method 2, which uses two threshold values in order to make the classification process more robust. Classifying pixels as Sky, Thick Clouds or Thin Clouds;
- Cloud Index Method 3, which is similar to the second one but also uses the pixel distance to the Sun to improve the circumsolar brightness effect.

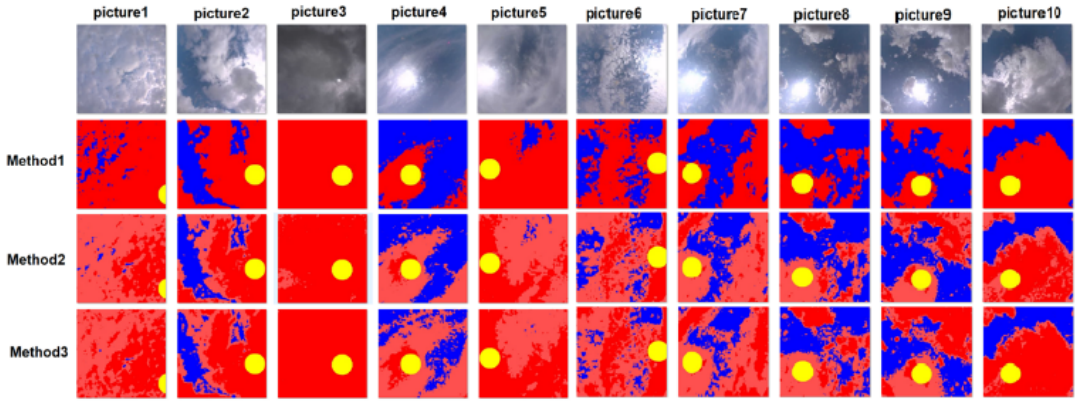
In order to be able to compute the above mentioned methods, several intermediate steps of image transformation are done. On the one hand, the fish eye lens of the ASI introduces a radius distortion in the image [1], which need to be corrected. On the other hand, the Sun location in the image, the Sun masking (to reduce pixel brightness), the distance of each pixel to the Sun Location and, the computation of the red-blue ratio (RBR) are done in order to allow the classification of clods [2].

These steps are depicted in the Figure bellow:



In order to test the developed methods of cloud identification a case study was conducted using a set of ten ASI pictures. These ASI pictures were chosen to be representative of different sky and clouds conditions.This way, the methods are tested in a range that varies from heavy clouds to almost clear sky conditions.

The results are depicted in the Figure below:



Before analyzing each picture, it is important to notice that **Method1** is not able to correctly classify the clouds since it only uses one single threshold to analyze the picture. Thus, the analysis mainly focused on **Method2** and **Method3**.

With this case study, some key points were obtained. **Method3** when applied to picture1 provides a better cloud classification. Contrary to **Method2**, which considers some pixels as sky when in fact they are thin clouds. In the case of picture2, the same analysis can be concluded. In the sky region on the left down part of the image, **Method3** have a better performance than **Method2**.

All the methodologies are being performed in a similar way in picture3, which depicts an image of heavy clouds. Nevertheless, it is noticeable in the original picture that some clouds are denser (or thicker) than others. Alternatively, **Method2** was able to select a certain region of thin clouds but was not fully effective doing this task.

The application of **Method3** in picture4 provides a better capability of distinguishing thick clouds from thin ones. The implementation of **Method2** in picture5, was able to detect a sky region between thick and thin clouds while Method3 failed to do so. Regarding picture6, **Method3** is deemed a visually better fit for the cloud and sky pixel classification. However, some clear sky pixels were wrongly classified as thin clouds.

The case in which the Sun is completely visible, i.e., without clouds naturally masking it, portrayed in picture7 to picture9, the **Method3** offers an overall better performance. Nevertheless, the circumsolar region is still causes some issues regarding the classification of pixels. In the last picture, picture10, **Method3** is shows a better representation of the original picture.

References:

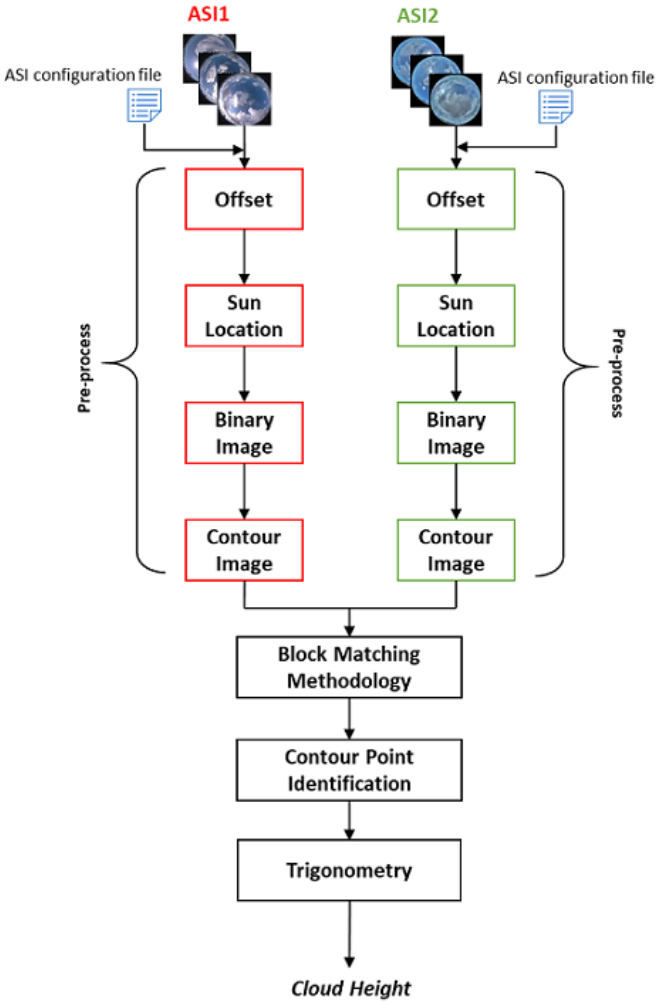
[1] R. Szeliski, Computer Vision, Algorithms and Applications (2011, Springer).

[2] M. S. Ghonima, B. Urquhart, C. W. Chow, J. E. Shields, A. Carzola and J. Kleissl, "A method for cloud detection and opacity classification based on ground based sky imagery", Atmospheric Measurments Techniques, vol. 5, pp. 2881-2892, 2012.

Cloud Height Estimation using two All-Sky Imagers

Following the lines of all-sky imager (ASI) research, R&D NESTER acquired on 2020 a new equipment [1] in order to proceed with different studies. The first approach was to develop a methodology to **estimate cloud height** using two ASI's.

This research utilizes pictures from two ASI's, distanced from 2.54 km, in order to develop a tool to estimate cloud height. The images are subjected to a **pre-process stage** in which different calculations and images transformations are performed, as shown in the Figure below:

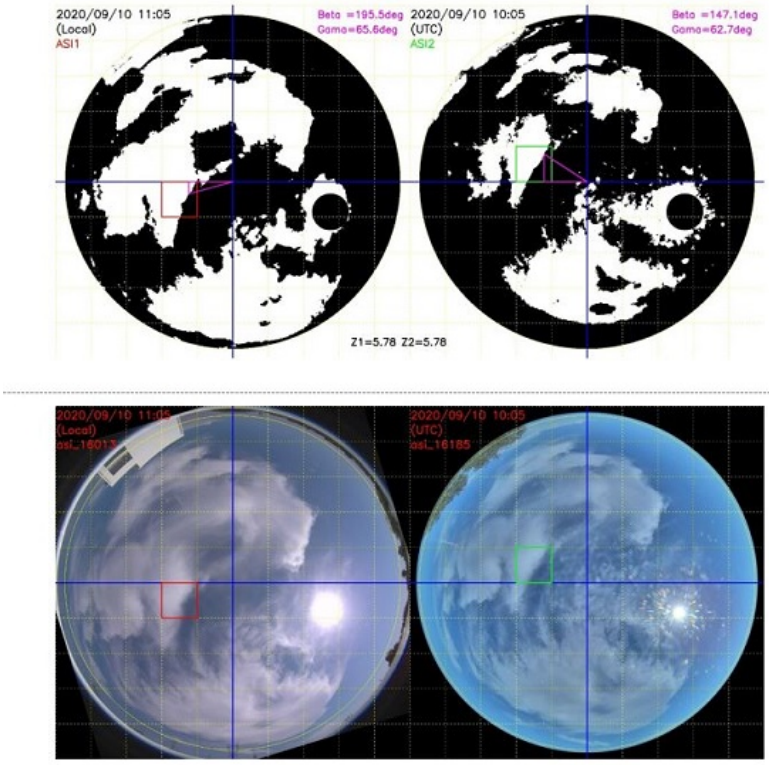


The pre-process stage is divided into four main stages. On a first step, an **offset** angle is applied order to have both images aligned correctly in the North-South axis. Following this step, the **Sun location** is computed in terms of pixel coordinates (x,y). In the third step, the **Binary Image** is created in order to allow the identification of cloud pixels and sky pixels [2]. The last pre-process step consists on creating the **Contour Image** that only contains the cloud contours.

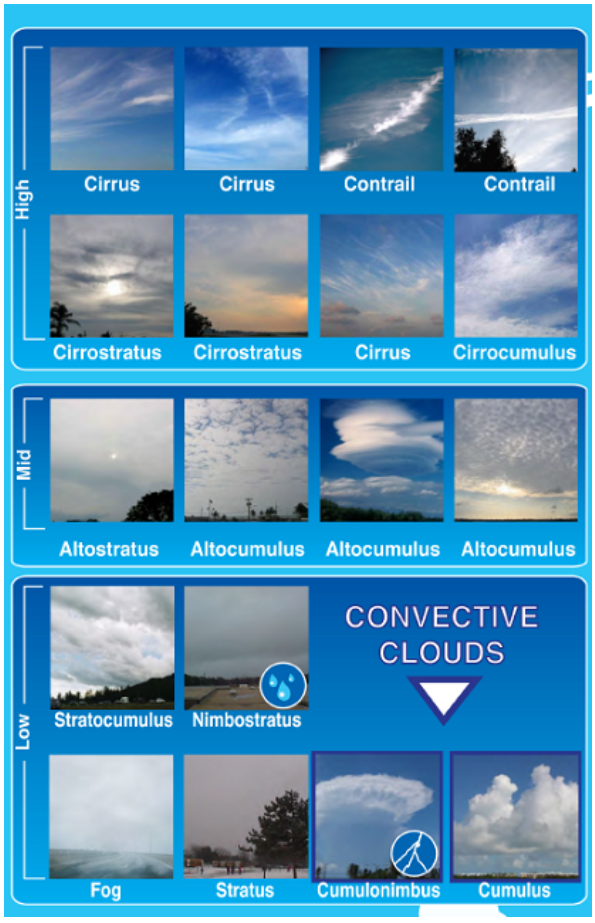
Following the pre-process stage, the development of the methodology to estimate the cloud height is based on:

- The interpretation of the **relative position of the two ASI**.
- The definition of a set of **trigonometry equations** that allow the calculation of the cloud height and.
- Retrieving information from the ASI's, namely the **position of the same cloud** [3] in both ASI's and the angles that characterize their positions.

A case study was conducted in order to test the developed methodology. Several ASI images from different dates and time were selected. In the example shown in the Figure bellow, the estimated **cloud height is about 5.78 kilometers**. One can observe that for such high cloud height, the same clouds are easily identifiable in both ASI images despite their distance:



The **estimated cloud height** is under the range of *Altostratus* and *Altocumulus* defined in the Figure bellow [4]. These clouds can range a cloud height from two to seven km.



References:

[1] schreder-cms, "Products-Cloud Detection/All Sky Measurments," [Online]. Available: http://www.schreder-cms.com/en/camera.htm. [Accessed 27 01 2021].

[2] M. S. Ghonima, B. Urquhart, C. W. Chow, J. E. Shields, A. Cazorla and J. Kleissl, "A method for cloud detection and opacity classification based on ground based sky imagery," Atmospheric Measurment Techniques, vol. 5, p. 2881-2892, 2012.

[3] Z. Wang, A. Conrad Bovik, H. Rahim Sheikh and E. P. Simoncelli, "Image Quality Assessment: From Error Visibility to Structural Similarity," IEEE Transactions on Image Processing, vol. 13, no. 4, pp. 600-612, April 2004.

[4] NASA, "Sky Watcher Chart," [Online]. Available: https://www.jpl.nasa.gov/edu/pdfs/sky_cloudchart.pdf. [Accessed 10 02 2021].

LITERATURE REVIEW

ACER present position paper on Infrastructure efficiency: the role of regulation in incentivizing smart investments and enabling the energy transition

The EU Agency for the Cooperation of Energy Regulators (ACER) published a new Position Paper inquiring the role of regulation in incentivising smart investments to improve the efficient use of electricity transmission assets.

ACER believes special focus should be given on how to facilitate the most efficient use of the existing grid and technologies, in order to enable the energy transition effectively. In this context, the regulatory framework has an important role to play in promoting innovative investments and providing the right incentives to increase the efficiency of the electricity transmission network.

ACER concludes the introduction of a benefit-based remuneration scheme can potentially represent a strong incentive for regulated entities to improve their efficiency, both when utilising future and existing infrastructure.

Read the ACER Position Paper to find out more.

ACER
Agency for the Cooperation of Energy Regulators

ENTSO-E on The Role of Hydrogen

ENTSO-E welcomes the current European common efforts to develop a new role for hydrogen in the decarbonisation of the energy system, embodied in the upcoming Hydrogen and decarbonised gas market package.

In a brief paper, ENTSO-E addresses the new roles of hydrogen, the business case to use hydrogen in an electricity system, and the Planning and operating hydrogen in ‘one system of systems'.

Read the full paper here.

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APREN Yearbook 2021 Edition

The 2021 Edition of the APREN Yearbook, a milestone in the national energy panorama and a showcase of what it's done in Portugal in the sector of electricity production from renewable sources.

Since 2007, APREN has been contributing annually with its Yearbook, for a better understanding of the entire universe of renewable electricity in Portugal. The year of 2020, due to the pandemic situation, is another one in which APREN intend to illustrate the importance of this sector for Portugal, both in the present, but also with regard to our future. This is a document that is already a milestone for the electricity sector and that has been used as a work tool by numerous entities.

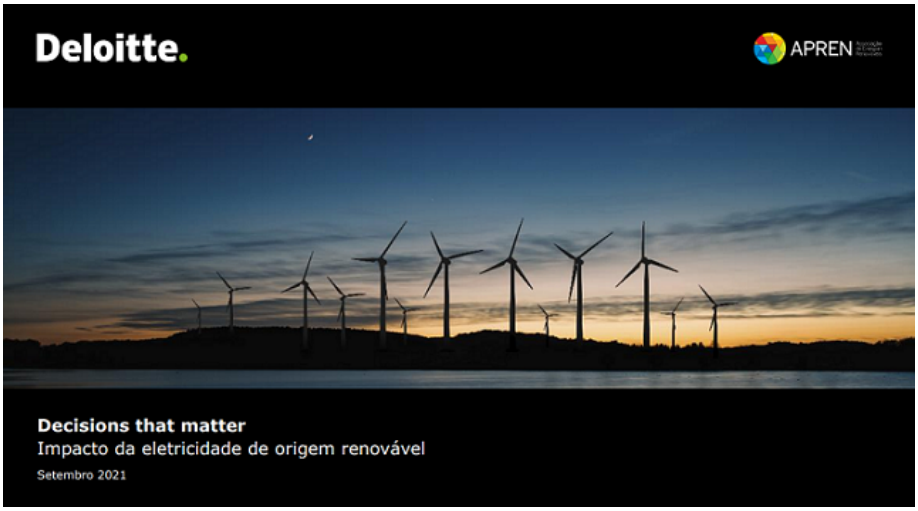


Link for Publication

APREN – Study on the Impact of Renewable Electricity “Impacto da Eletricidade de Origem Renovável”

The study on the impact of electricity from renewable sources carried out by the consultancy Deloitte for the Portuguese Association of Renewable Energies (APREN) shows that renewables have contributed 18.5 billion euros to the Portuguese GDP in the space of five years (3, €7 billion per year), thus representing around 1.9% of GDP.

This study assessed the impact and contribution, between 2016 and 2020, of electricity from renewable sources on the bill of consumers, on the electricity system and on the national economy, projecting its effects in the context of energy policy and objectives established in the National Energy and Climate Plan for Portugal until 2030, and also looking at the new climate ambition established by the European Union, present in the European legislative package "Fit for 55%", launched last July.



Link for Publication

EVENTS

6 -7 Dec 2021

MACAU

PORTUGAL-CHINA SCIENTIFIC RESEARCH COOPERATION CONFERENCE

7 -7 Dec 2021

LIVE-STREAMED FROM BRUSSELS, BELGIUM

ENTSO-E CONFERENCE "OPTIMISING ENERGY AND EMPOWERING NATURE"

17 -17 Dec 2021

ONLINE WORKSHOP

EERA EU ENERGY POLICY REVIEW: IMPACT ON RENEWABLE ENERGY

25 -28 Mar 2022

CHENGDU, CHINA

AEEES 2022

2 -3 Jun 2022

OPORTO, PORTUGAL

CIRED PORTO WORKSHOP 2022 - E-MOBILITY AND POWER DISTRIBUTION SYSTEMS

27 -1 Jun /Jul 2022

OPORTO, PORTUGAL

XXII POWER SYSTEMS COMPUTATION CONFERENCE

28 -2 Aug /Sep 2022

PARIS, FRANCE

CIGRÉ SESSION 2022

24 -27 Oct 2022

SAINT PETERSBURG, RUSSIA

25TH WORLD ENERGY CONGRESS 2022

QUIZ

1) WHICH TYPE OF ENERGY STORAGE SYSTEM USES MECHANICAL ENERGY TO STORE ENERGY?

- (a) Capacitors
- (b) Flywheel
- (c) Superconducting magnetic energy storage
- (d) Flow battery

2) ALTHOUGH BATTERIES HAVE AN OPERATIONAL TEMPERATURE RANGE RELATIVELY COMPREHENSIVE, GENERALLY BETWEEN 0 AND 45ºC, FOR AN INCREASE OF THE EFFICIENCY OF THE CHARGING/DISCHARGING PROCESS THE RANGE SHOULD BE SHORTEN.

4) WHICH OF THESE ENERGY STORAGE SYSTEM TECHNOLOGIES HAS TYPICALLY LOWER EFFICIENCY?

- (a) Li-Ion batteries
- (b) Superconducting magnetic energy storage
- (c) Double-layer capacitors
- (d) Thermal Energy storage

5) AN ENERGY STORAGE SYSTEM UTILIZING BATTERY TECHNOLOGY IS GENERALLY COMPOSED BY WHICH OF THE FOLLOWING COMPONENTS:

- (a) Batteries including the racking and battery management system

(a) True
(b) False

3) WHICH STORAGE ENERGY SYSTEM NEEDS TO BE STORED AT -240ºC TO HOLD ENERGY?

(a) Flow battery
(b) Flywheel
(c) Fuel cells
(d) Superconducting magnetic energy storage

(b) The Power Conversion System (PCS)
(c) The building/containers to house the system
(d) All the above

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) Flywheel
2. Answer: (a) True
3. Answer: (d) Superconducting magnetic energy storage
4. Answer: (d) Thermal Energy storage
5. Answer: (d) All the above



LINKS

ON RESEARCH, DEVELOPMENT AND INNOVATION

Portugal

- Portugal 2020
- Portal da Inovação
- Agência Nacional de Inovação
- 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)

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

OTHER ENTITIES

Portugal

- Laboratório Nacional de Energia e Geologia (LNEG)
- 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

- 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)
- Joint Research Centre - Smart Electricity and Interoperability
- The European Commission's Priorities
- A European Green Deal | European Commission
- 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
- European Distributed Energy Resources Laboratories (DERlab)

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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