R&D NESTER

19 NL out 2020

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EDITORIAL | HIGHLIGHTS | TECHNICAL INFORMATION | LITERATURE REVIEW | EVENTS | LINKS | QUIZ - This specific Quiz deals with concepts related to substations. The definitions have been taken from www.electropedia.org



EDITORIAL

Dear Reader,

The energy system is witnessing a fast-changing generation mix dynamic, mostly due to an increase of renewable energy sources and an increase of distributed assets, namely distributed generation, flexible loads, distributed storage, electric vehicles, among others.

Furthermore, it is also introducing new market models, with the increased participation of the customer, e.g., energy communities, the prosumer, auto-consumption, peer-to-peer trading, and with the smartening of the networks, associated with a descentralization of control and operation.

These elements alone are a challenge to the operation of this increasingly complex energy system in a secure and efficient manner. The more intense fluctuation of energy influx on the generation side and the more intense dynamics also on the consumer and loads side, claim for an increased flexibility in the system in order to balance at all moments the generation with the consumption.

As one of the sources of flexibility and also of energy system efficiency, the coupling of energy sectors is receiving increased attention, in particular the coupling of electricity, gas, heat and cooling, liquid fuels, transport sector, among others, allowing a more enlarged pool of resources and infrastructure to adapt to the momentary conditions of the energy generation and demands.

The effective and efficient control and operation of this complex system depends on reliable and structured data and on its timely availability. This is leading to the deployment of an extended and more capillar network of sensors, (smart)meters, microprocessors and communications infrastructure, that allow the emergence of new digital services and new business opportunities. These are appearing in areas such as load management, storage management, energy efficiency in domestic and industrial sectors, prosumer support, smart charging and electric vehicles management, or local energy communities and smart cities. All these benefit from being powered by sophisticated analytic methodologies like machine learning, artificial intelligence, big data management, among others. The development of open data platforms allow a wider and more diverse participation of players and an increased transparency that can benefit the whole energy system.

This is (part of) what we call a "Smart Energy System". Read below how we at R&D Nester are "creating a smart energy future"!

Enjoy your reading!

Sincerely,

Nuno de Souza e Silva

Managing Director

HIGHLIGHTS

R&D Nester represented in CIRED 2020 workshop, with 2 papers on system operators coordination and flexibility markets

From 22 to 23 September, R&D Nester was represented in this year's edition of the CIRED Workshop.

CIRED 2020 Berlin Workshop Online | 22 - 23 September
How to Implement Flexibility in the Distribution System?

CIRED is the International Conference and Exhibition on Electricity Distribution.

CIRED's workshops on specific topics in this area are organized every two years between CIRED main conferences.

Due to the current situation of covid-19 pandemic, this year's edition changed its format into a Workshop Online that addressed "How to Implement Flexibility in the Distribution System?".

In this online edition R&D Nester was the co-author in two papers that were presented.

One paper is entitled "INTERRFACE: TSO-DSO-Consumer interface architecture to provide innovative grid services for an efficient power system, end users' requirements". Its content was produced in the scope of R&D Nester participation in EU project "INTERRFACE" that addresses "TSO-DSO Consumer INTERFACE aRchitecture to provide innovative grid services for an efficient power system" and which main objectives are: 1) Design, develop and exploit the interoperability of a pan-European network service architecture to act as an interface between the TSO and DSO and customers; 2) Enable the integrated and coordinated operation of all stakeholders for the use and acquisition of common services.

Another paper is entitled "Implementation of a local flexibility market for solving network issues". Its content was produced in the scope of R&D Nester participation in EU project "GIFT" that addresses "Geographical Islands Flexibility", with an innovation action aiming at decarbonising the energy mix of European islands, willing to develop innovative systems to allow islands to integrate vast amount of renewables.

For more information:

INTERRFACE Project

GIFT Project

Conference website

R&D Nester represented in EEM20 conference, with 2 papers on demand response, balancing markets and flexibility

From 16 to 18 September, R&D Nester was represented in this year's edition of the International Conference on the European Energy Market - EEM20.

17th INTERNATIONAL CONFERENCE ON THE EUROPEAN ENERGY MARKET
16 - 18 September 2020, Stockholm, Sweden

The EEM conference has gained a strong reputation in both European and international levels for providing an excellent ground for experts to discuss a wide range of issues regarding the energy markets worldwide.

Due to the restrictions imposed by SARS-CoV-2, the organization moved the conference to a virtual conference room, and the event was an online webinar.

In this 17th edition R&D Nester was the co-author in two papers that were presented.

One paper is entitled "Comparative Assessment of Demand Response Participation in Selected European Balancing Markets". Its content was produced in the scope of R&D Nester project FleXunity that addresses "Scaling-up Power Flexible Communities business models empowered by Blockchain and AI".

Another paper is entitled "Considering flexibility in network expansion planning: present practices and regulatory conditions". Its content was produced in the scope of R&D Nester project FlexPlan that addresses "advanced methodology and tools taking advantage of storage and FLEXibility in transmission and distribution grid PLANning".

For more information:

FleXunity Project

FlexPlan Project

FlexPlan Project Website

Conference website

R&D Nester develops Pan-European energy scenarios until 2050 time horizon

R&D NESTER team developed, in an activity performed in the scope of the FlexPlan project, pan-European energy scenarios for three target years: 2030, 2040 and 2050. This activity was developed with the contribution of several partners from the project including grid operators (TERNA, ELES, REN) and research institutions (SINTEF, TU-Dortmund and RSE).

These energy scenarios aim to present different alternatives for the European energy landscape in the considered timeframes and will be used as the main data source to validate the planning tool developed in this project.

This validation will be performed using six regional case studies, involving multiple European countries and whose developments will be performed in a work package leaded by R&D NESTER.



In the performed activity, three different scenarios were considered per target year, totalizing nine scenarios at project level. Complementary, these scenarios were created using well-known and accepted data sources from the industry and academic international communities, obtaining a validation of the created scenarios in this conception phase.

The scenarios developed for 2030 and 2040 are majorly based in the TYNDP 2020, recently released by ENTSO-E and available at https://tyndp.entsoe.eu/.

2050 scenarios are an R&D NESTER adaptation to the previous source, validated using data from the long-term strategy for energy and climate from the European Commission - A Clean Planet For All - available at: https://ec.europa.eu/clima/policies/strategies/2050_en.

Each scenario presents a pan-European landscape for energy and includes:

- Total installed capacity per country (and per technology)
- Annual capacity factors for renewable energy sources
- Annual electricity consumption and peak load
- Hourly time series data for consumption
- Net transfer capacities (NTCs)
- Total operational reserve power (FCR, FRR)
- Commodity prices for different types of fuel for nuclear and fossil power station.

The description of the methodology used in the scenario development and the description of additional data used in the project are published in a deliverable (D4.1) created by R&D NESTER, which is publicly available at the FlexPlan website, in https://flexplan-project.eu/publications/.

FlexPlan is a three-year project financed by the Framework Programme Horizon 2020. It started in October 2019 and is developed in a consortium with 13 partners from 8 European countries, including multiple grid operators from transmission and distribution systems. R&D NESTER and REN are active members of this consortium. All project details can be checked at: https://flexplan-project.eu/.

The project aims to create an innovative grid-planning tool, which introduces multiple new functionalities, core to grid planning activities in the current and future power systems context. These include, among other, the utilization of flexibility sources as alternatives to traditional grid expansion measures, probabilistic methods for contingency analysis (replacing or building upon the N-1 criteria) and a full environmental impact study of the different grid expansion measures considered.

R&D NESTER is participating in 37th EU PVSEC, presenting one poster on “solar power forecast using satellite pictures”

From 7 to 11 September, R&D Nester participated in this year's edition of the European Photovoltaic Solar Energy Conference and Exhibition.



The EU PVSEC is the largest international Conference for Photovoltaic research, technologies and applications, and at the same time a top international PV Industry Exhibitions. It gathers the global PV community to conduct business, to network and to present and discuss the latest developments and innovations in Photovoltaics. It is the world renowned science-to-science, business-to-business and science-to-industry platform with a full and only focus on the global PV Solar sector.

Due to the current situation of covid-19 pandemic, this year's edition changed its format. Instead of traditional face-to-face sessions, the conference was virtual.

In this 37th edition R&D Nester presented a poster entitled "Solar Power Forecast using satellite pictures".

The content of this poster was developed in the scope of the RESFOR Project entitled "Renewable Energy Power Forecasting Model Research and Prediction Results Analysis".

For more information:

RESFOR Project

Conference website

R&D NESTER participates in annual CIGRE conference, with two communications

From August 24th, until September 3rd, R&D Nester participated in this year's edition of the CIGRE Conference.



Established in 1921 in Paris, France, CIGRE is a global community committed to the collaborative development and sharing of power system expertise. The community features thousands of professionals from over 90 countries and 1250 member organisations, including some of the world's leading experts.

At its heart are CIGRE's 59 in country National Committees offering diverse technical perspectives and expertise from every corner of the globe.

CIGRE operates the world's foremost knowledge programme, spanning 16 domains of work encompassing all the core areas of the power system. Across these domains 250+ Working Groups draw and build on practical expertise to solve existing and future challenges facing the power system.

Due to the current situation of covid-19 pandemic, this year's edition was forced to change its format. Instead of traditional face-to-face sessions, the conference was virtual.

R&D Nester made the following 2 presentations:

"Remote monitoring overhead lines using satellite images"

This work presents the use-cases underlying the development of two satellite-based services designed to perform remote monitoring and automatic control of the right-of-ways' (RoW) field management activities and for the planning of new critical infrastructures. These services aim at supporting the Transmission System operators, among other potential users, in delivering cost-efficient security of supply with regard to environmental protection.

"To socialise or not to socialise the cost of imbalances from non-programmable renewable generation"

This work studies two different models for integrating non-programmable electricity generation from renewable energy sources in the Portuguese electricity market: 1) guaranteed remuneration with socialised imbalance costs and 2) spot market remuneration without socialised imbalance costs.

For more information:

Conference website

SIMMRES Project

Participation of R&D Nester and REN in the European project Osmose contributes to the improvement of the IEC 61850 standard

The document 'IEC61850 ENTSO-E Profile introduction and Engineering Process Refinement' was recently published on the website of the European project OSMOSE (Optimal System-Mix of Flexibility Solutions for European Electricity), of which REN and R&D Nester are partners, integrated in a consortium including 32 organizations.



This document was prepared under Task 7.1 (interoperability) of the project, which explores the potential of the international standard IEC 61850 in the communication between intelligent electronic devices (IEDs) existing in substations, such as protection relays, bay units and central units. Interoperability between devices is extremely important, as it allows components of the same system to be purchased from different suppliers, with the inherent technical and economic advantages.

One of the characteristics of this standard is the existence of a description language (SCL - System Configuration Language) allowing the global configuration of protection, automation and control (PAC) systems, even though it involves configuration tools from various manufacturers, that is, there is also interoperability between configuration tools.

The purpose of the document is to present an engineering process, that is, a set of steps for the configuration of the PAC system, developed by the project team, and which constitutes an improvement over what is defined in the IEC 61850 standard.

This engineering process includes extensions to the IEC 61850-6 (the part of the standard that defines the SCL), which will be validated on a demonstration platform installed in the R&D Nester laboratory, where IEDs from various manufacturers are installed, having the specification and system configuration been made by independent tools. In this process, all steps of the development of a PAC system project are considered: standardization, specification, procurement, configuration and also installation and commissioning.

The project team combined the work developed by the ENTSO-E working group, which created a specification tool capable of generating function and signal templates, which will then be imported by specification and configuration tools. On the other hand, the results of this task will be communicated to the community (standardization bodies and industry), so that the IEC 61850 standard can be improved, with the correction of gaps and ambiguities.

This way, TSOs will be able to use the IEC 61850 standard, not only at the configuration step of PAC systems, but also may use it as a support for the specification and consequent procurement. These developments will thus enable the technical and economic efficiencies mentioned above.

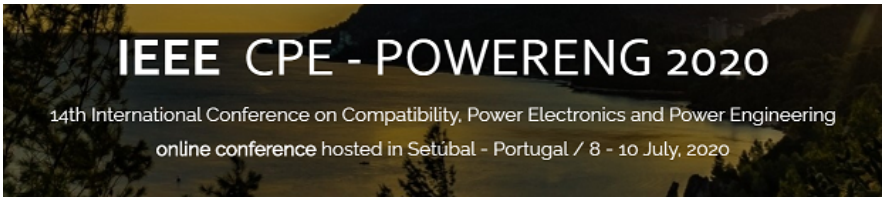
Link for Publication

Project website

RDNester/OSMOSE Project

R&D NESTER participated in IEEE conference CPE-Powereng 2020, with two communications on planning, renewables and storage

On 8-10 July, R&D Nester participated in this year's edition of the IEEE CPE-POWERENG, XIV International Conference on Compatibility, Power Electronics and Power Engineering.



Due to the current situation of covid-19 pandemic, this year's edition was forced to change its format. Instead of traditional face-to-face sessions, the conference was virtual.

CPE-POWERENG is an important conference of the IEEE Industrial Electronics Society (IES) devoted to the dissemination of new ideas, research and work in progress within the fields of power electronics, renewable energy integration, power generation, transmission and distribution, power systems, electro-mechanical energy conversion, automation and EMC/EMI issues.

This conference Committee is composed by School of Science and Technology of Nova University (Portugal), School of Technology-Polytechnic Institute of Setubal (Portugal) and Gdansk University of Technology (Poland).

The 2 papers of R&D Nester were produced in the scope of the work developed in 2 of its current projects, namely "GRID4RES" and "INTERPRETER", and are entitled, respectively, ."Improving grid security in the presence of a high penetration of RES through optimal planning and operation of distributed energy storage devices" and "Optimizing nodal capacity allocation using risk assessment of element failure rate".

For more information:
http://cpe-powereng2020.uninova.pt/
Grid4RES project
Interpreter Project

R&D NESTER's work on inertia in the electrical system

Within the scope of one of the R&D Nester projects with REN (the Portuguese TSO), the themes "Phenomena of low inertia in the electrical system", "Use of WAMS (Wide Area Monitoring System) to assess low frequency oscillations in the electrical system" and "Definition of WAMS alarms" have been studied and analysed.

Regarding the "Phenomena of low inertia in the electrical system", the last 10 years were analyzed and the moments of "low inertia" were quantified based on criteria of quantity of MW of inertia and percentage of inertia in relation to the quantity of generation. The results showed that 2019 was the year where the occurrence of such situations was highest. It is also possible to check the trend over these 10 years.

Regarding "Use of WAMS (Wide Area Monitoring System) to assess low frequency oscillations in the electrical system", 8 events in Iberia and the rest of Europe were analyzed, which allow a better understanding of these phenomena and how to detect them.

Finally, regarding the "Definition of WAMS alarms", the previous work described above, allowed to identify a set of suggestions

for the definition of alarms for the national electrical system.

Further work is still being pursued.

For any questions, contact R&D Nester (www.rdnester.com).

R&D Nester participates in the annual conference on real-time simulation, RT20

R&D Nester shared its experience in Real Time Power System Simulation (RTPSS) and Hardware In the Loop (HIL) at the RT20 conference on real-time simulation, organized by OPAL-RT.



This conference brought together people from all over the world, from industry to universities, to share their knowledge of real-time simulation applied in areas such as Energy Systems, Power Electronics, Electric Mobility and Aerospace & Defense.

R&D Nester presentation "Testing of PAC Solutions in HIL Using HYPERSIM" focuses on its experience obtained in projects in the area of Command, Control and Protection Systems, namely the projects of the Substation of the future and Protections over IP/MPLS, works that have been developed with REN (the Portuguese TSO) over the past few years.

For more information: Conference website.

TECHNICAL INFORMATION

Energy Storage Systems: characteristics and applications

Generally, the Energy Storage Systems (ESSs) emerge as crucial agents so that renewable energy sources can be seen as reliable primary energy sources. They are often the solution for several operational problems triggered by the increase of the intermittent renewable penetration in the energy mix.

Different ESSs can be classified according to their distinct characteristics in terms of the form in which the energy is stored or based on their projected functions and main applications. The Figure 1 shows the main types ESSs according to their energy storage type and presents some examples of ESSs per category.

Mechanical	Chemical	Electrical	Thermical	Electrochemical
•Pumped Hidro Storage (PHS) •Flywheel Energy Storage (FES) •Compressed-air Energy Storage (CAES)	•Fuel cell	•Superconducting Magnetic Energy Storage (SMES) •Double Layer Capacitors (DLC)	•Thermal Energy Storage (TES)	•Battery Energy Storage System (BESS) •Flow Battery Energy Sotrage (FBES)

Figure 1 - Classification of the ESS according to their energy storage form

Also, the ESSs can be classified based on their energy density, power density or based in their response time. Different applications with

different requirements demand different features from the storage systems. The ESSs with high energy are related to applications associated with the energy management allied to the reduction of the costs of the energy system exploration, helping in the profitability of the electro-producers systems. On the other hand, the ESSs with high power are used to provide productivity, security and reliability, providing technical benefits to the operation of electro-producers systems and increasing the quality of service.

In the Figure 2 is presented a comparison of rated energy capacities, power rating and discharge rates of different types of EES technologies. By analysis of the Figure 2, the FESs, SMESs, DLCs and small BESSs are usually systems with high rated power and discharge rates lower than 1 hour and therefore preferable to applications to ensure the quality of service in which fast response and high power rate are needed.

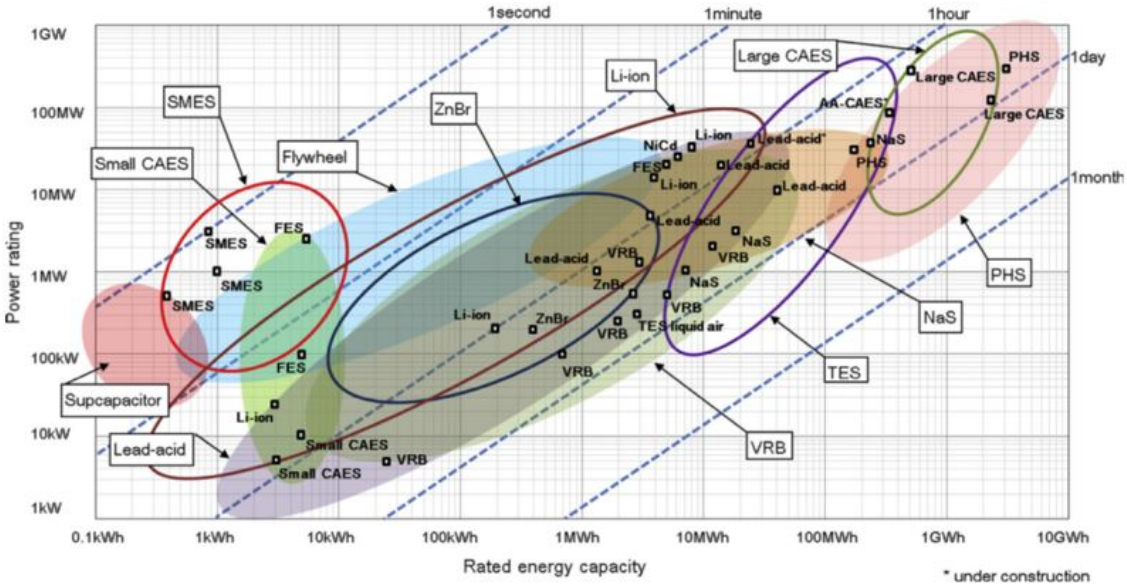


Figure 2- Nominal power and rated energy capacity with discharge rate of different ESSs

On the other and, the PHSs, CAESs, BESSs of high capacity and TES can operate at nominal power for longer periods and have higher capacities, consequently are normally ESSs used of energy applications related with energy management.

Different applications with different requirements need specific characteristics by the ESSs. An analysis, from a technical, economic and environmental perspective is fundamental for the careful choice of the appropriate storage technology. Some of the main proprieties that need to be taken into consideration for choosing an ESSs are: efficiency, life-time, self-discharge, number of cycles, response time, discharge rate, cost, energy density, power density, power rating and energy capacity.

The main applications for the ESSs can be divided, as previously mentioned, into energy applications (energy management) and power applications (quality of service). Regarding energy applications can be highlighted the **time shifting/peak shaving** that consists in the storage of energy in periods in which the energy is cheaper (valley hours) to be sell/used in periods more viable economically (peak hours) and the **load following** that involves the use of ESSs to support the load changes in the electricity demand, among others applications. For the power applications, the **voltage and frequency regulation and control** are the more notable ones.

In short, it is possible to say that there are a range of factors to be considered to choose the right ESSs for a certain purpose, because there is not a single storage system qualified to meet all the requirements imposed by the increase of the renewable penetration and the need to mitigate the intermittencies in the electricity sector. However, the ESSs are a crucial piece for the future energy system since asthey can provide diverse solutions to the reliability and profitability of the electrical system.

References:

"Overview of current development in electrical energy storage technologies and the application potential in power system operation", Xing Luo, Jihong Wang, Mark Dooner, Jonathan Clarke

Unleashing the potential of floating solar production

Floating PV (FPV) have the potential of generating a significant amount of energy, by taking advantage of the water area and cooling. FPV generation is an exciting emerging market, with lots of potential for fast growth. These systems are currently considered as an alternative to traditional fields and rooftops applications. This is especially relevant for islands or land-constrained regions.



The disadvantage is the technology's investment cost, which can reach 2 to 3 times the traditional PV. Nonetheless, the LCOE (levelized cost of energy) is similar to the ground-mounted systems (World Bank Group, 2018). However, this technology presents several advantages when compared with the traditional PV solutions. For example, the cost of water surface is generally lower than the cost of land (GlobalData, 2018), the efficiency of the panels is higher due to the lower temperature of operation, it has lower operation and maintenance costs and it also contributes to the decrease of evaporation (IRENA, 2019).

Several countries are investing in this technology, especially in some regions of Asia where land is scarce. In Portugal, a power producer is taking the first steps with this technology with a pilot in Alqueva with 4MW capacity (https://www.edp.com/en/innovation/floating-solar-pannels). An auction was recently launched in Portugal for 50 MW of FPV. However, worldwide, there are already several power plants with over a dozen of MW each. China has successfully installed a 40MW FPV power plant in Huainan in 2018, spanning 800,000 square meters and another one with 150 MW FPV is being built in Anhui province. At the same time South Korean energy company EN Technologies announced the signature of an agreement to develop pilot projects of 2.1 GW in a floating solar site planned near the Saemangeum tidal flat, on the coast of the Yellow Sea.

LITERATURE REVIEW

Science, Research and innovation Performance of the EU 2020 – A fair, green and digital Europe

The report ‘Science, research and innovation performance of the EU 2020' (SRIP 2020) analyses how Europe fares in science, technology and innovation in the fast-changing global context.

The report presents how research and innovation (R&I) policy needs to adapt to become more transformative and deliver on an ample concept of sustainability (social, environmental and economic) while driving the EU's competitiveness.

This Report shows how R&D can contribute to a sustainable, competitive, inclusive, digital and knowledge-based Europe. The evidence in the SRIP 2020 report leads to 11 policy recommendations that support Europe's agenda for people, planet and prosperity.



Link for Publication

Energy Technology RD&D Budgets 2020

The Energy Technology RD&D budgets database includes data on budgets in national currencies (in nominal and real prices), in USD (at latest year prices and exchange rates), in USD (at latest year prices and PPP) and in Euro (at latest year prices and exchange rates). Also, the database shows RD&D budgets and calculating indicators.

The government energy technology RD&D budgets are submitted on an annual questionnaire every year to the IEA Secretariat by appropriate Administrations in national currencies.

The exchange rates are published in Main Economic Indicators (OECD) and the GDP and GDP deflators come from the National Accounts (OECD).



Link for Publication

European Innovation Scoreboard 2020

The European Commission released recently the European Innovation Scoreboard 2020, which shows that Europe's innovation performance continues to improve across the EU, surpassing for the second year the United States. However, according to the report, more needs to be done to catch up with global innovation leaders like South Korea, Australia and Japan.

The results, which cover data from 2019, highlight the opportunities to better coordinate EU innovation policies, help Europe improve its global competitiveness and strengthen the key role innovation plays in overcoming the coronavirus pandemic.

The 2020 European Innovation Scoreboard shows that the innovation performance continues to increase at a steady pace. Within the EU, the positive convergence in performance between Member States has continued from previous years. The withdrawal of the United Kingdom from the EU earlier this year has had a small impact on the EU's average innovation performance, but has not affected the relative performance of Member States or the EU's global performance. At the international level, the EU maintains a performance lead over the United States and China, but still has a gap with some competitors including Japan and South Korea.

The 2020 European Innovation Scoreboard will support the development of policies to enhance innovation in Europe and inform policy makers in a rapidly evolving global context. Everyone counts - researchers, innovators, investors, and policy-makers - to accelerate the green and digital transitions in Europe, with innovation leading the way for the future.



Link for publication

World Energy Council – Jun2020

This Innovation Insights brief on electricity transmission is part of a series of publications by the World Energy Council focused on Innovation.. In a fast-paced era of disruptive changes, this brief aims at facilitating strategic sharing of knowledge between the Council's members and other energy stakeholders and policy shapers.

Transmission companies and system operators around the world face new kinds of ‘off-grid' community opposition and competition from non-traditional energy providers. They are challenged to find ways to balance the trade-off between arriving too early with the wrong technology solution (e.g. battery and/or alternative to battery storage solutions) or hindering the speed of global energy transition by waiting until the fog of societal ambiguity and new technology risk becomes clear.

This study by the World Energy Council, in collaboration with PwC, provides timely insights on the challenges ahead and solutions emerging, based in interviews with 37 transmission companies, covering all regions of the world. Three strategic implications are clear: (1) the future of the grid involves investment in people and skills, as well as in the tools and infrastructure

required to anticipate and meet more mobile and dynamic demand; (2) transmission companies will need to play an increasingly active role in designing the new power ecosystem and securing their social license to operate; and, (3) cross-border and regional connected grid systems offer multiple benefits, including enhanced resilience but these systems may incur political risks.



Link for publication

World Energy Issues Monitor 2020

The World Energy Issues Monitor is published annually providing unique insight into what energy policymakers, CEOs and leading experts identify as Critical Uncertainties and Action Priorities. New this year, the Issues Monitor also provides readers with the views of the individual customer, detailing their perceptions of their role in the overall energy system.

The Issues Monitor report includes a global issues map, 58 country maps, and six regional maps, as well as perspectives from Future Energy Leaders (FEL) and energy innovators. The Issues Monitor and maps offer a range of opportunities for strategic conversations leading to a better understanding of the progression of the energy transition.

Within the supporting regional and national commentaries, new signals were detected that energy transition has entered a new era. The social costs and implications of accelerating global energy transition are becoming more pressing. We have started to shape and address the social energy agenda and reach out beyond the energy sector to engage new and non-traditional energy transition leaders.

This publication has looked at implications for the customer-centric energy future. The initial findings confirm that changes in behavior will not be automatic, without more active customer engagement. It's certain to say that the world has entered a new era of energy for humanity. Global energy transition is now being shaped by the 5Ds - decarbonisation, decentralisation, digitalisation, democratisation and demand-centric (energy-plus) services.

Focusing on actions at the human level and addressing the social impacts of an accelerating energy transition will contribute to healthy, harmonious and happy energy societies.

WORLD ENERGY COUNCIL

World Energy Issues Monitor | 2020



Link for publication

EVENTS

25 -28 Oct 2020

THE HAGUE, THE NETHERLANDS

IEEE-PES-ISGT EUROPE 2020 INNOVATIVE SMART GRID TECHNOLOGIES CONFERENCE

24 -27 Oct 2020

SAINT PETERSBURG, RUSSIA

25TH WORLD ENERGY CONGRESS WORLD ENERGY COUNCIL

11 -12 Nov 2020

(VIRTUAL EVENT)

19TH WIND INTEGRATION WORKSHOP INTERNATIONAL WORKSHOP ON LARGE-SCALE INTEGRATION OF WIND POWER INTO POWER SYSTEMS AS WELL AS ON TRANSMISSION NETWORKS FOR OFFSHORE WIND POWER PLANTS

20 -25 Aug 2021

PARIS, FRANCE

CIGRE CENTENNIAL SESSION

24 -27 Oct 2022

SAINT PETERSBURG, RUSSIA

25TH WORLD ENERGY CONGRESS 2022

24 -27 Nov 2020

VIENNA, AUSTRIA

SEERC CONFERENCE 2020 3RD CIGRE SOUTH EAST EUROPEAN REGIONAL COUNCIL - SEERC COOPERATION - SUSTAINABILITY - FUTURE

5 -5 Nov 2020

10TH SOLAR & STORAGE INTEGRATION WORKSHOP - INTERNATIONAL WORKSHOP ON INTEGRATION OF SOLAR POWER AND STORAGE INTO POWER SYSTEMS

LINKS

- ESA - The European Space Agency
- China Electric Power Research Institute (CEPRI)
- World Intellectual Property Organization (WIPO)
- International Energy Agency (IEA)
- International Electrotechnical Commission (IEC)
- EUASP - The European Union Agency for the Space Programme
- Eurostat - Science, Technology and Innovation
- A European Green Deal | European Commission
- Portugal in Europe Research and Innovation Network (PERIN)
- Horizon Europe
- European Network of Transmission System Operators for Electricity (ENTSO-E)
- The European Wind Energy Association (EWEA)
- Associação de Energias Renováveis (APREN)
- European Distributed Energy Resources Laboratories (DERlab)
- Portugal Energia
- Agência Nacional de Inovação (ANI)

QUIZ

1) 1) DURING 2019 IN PORTUGAL, ACCORDING TO THE INTERNATIONAL ENERGY AGENCY, SOLAR POWER ENERGY SUPPLY REACHED:

- a) 1275GWh
- b) 750GWh
- c) 3500GWh
- d) 2225GWh

2) 2) WHICH COUNTRY HAVE THE LARGEST (INSTALLED CAPACITY) SOLAR POWER PLANT IN THE WORLD?

- a) China
- b) Morocco
- c) Mexico
- d) Brazil

3) 3) THE BIGGEST FLOATING SOLAR POWER PLANT IS LOCATED IN ANHUI PROVINCE (安徽省), CHINA, WITH A TOTAL CAPACITY OF:

- a) 5MW
- b) 17MW
- c) 32MW
- d) 79MW

4) 4) THE TOTAL INVESTMENT IN ENERGY R&D BY NATIONAL GOVERNMENTS IN 2018 REACHED AROUND:

- a) 15 USD (2018) billion
- b) 22 USD (2018) billion
- c) 27 USD (2018) billion
- d) 36 USD (2018) billion

5) 5) IN 2018, EUROPEAN UNION, THE CO2 EMISSION DIFFERENCE BETWEEN THE ELECTRICITY AND HEAT PRODUCERS SECTOR AND THE TRANSPORT SECTOR WAS:

- a) 1050 Mt CO2
- b) 121 Mt CO2
- c) 458 Mt CO2
- d) 399 Mt CO2

6) 6) IN THE EUROPEAN UNION, THE CO2 EMISSION PER CAPITA WAS CALCULATED AS:

- a) 5.8 t CO2/capita
- b) 2.8 t CO2/capita
- c) 7.5 t CO2/capita
- d) 6.1 t CO2/capita

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

1. Answer: a) 1275GWh
2. Answer: a) China
3. Answer: c) 32MW
4. Answer: c) 27 USD (2018) billion
5. Answer: b) 121 Mt CO2
6. Answer: d) 6.1 t CO2/capita



EVENTS

LINKS

INFORMATION

QUIZ - This specific Quiz deals with concepts related to substations. The definitions have been taken from www.electropedia.org

REVIEW

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