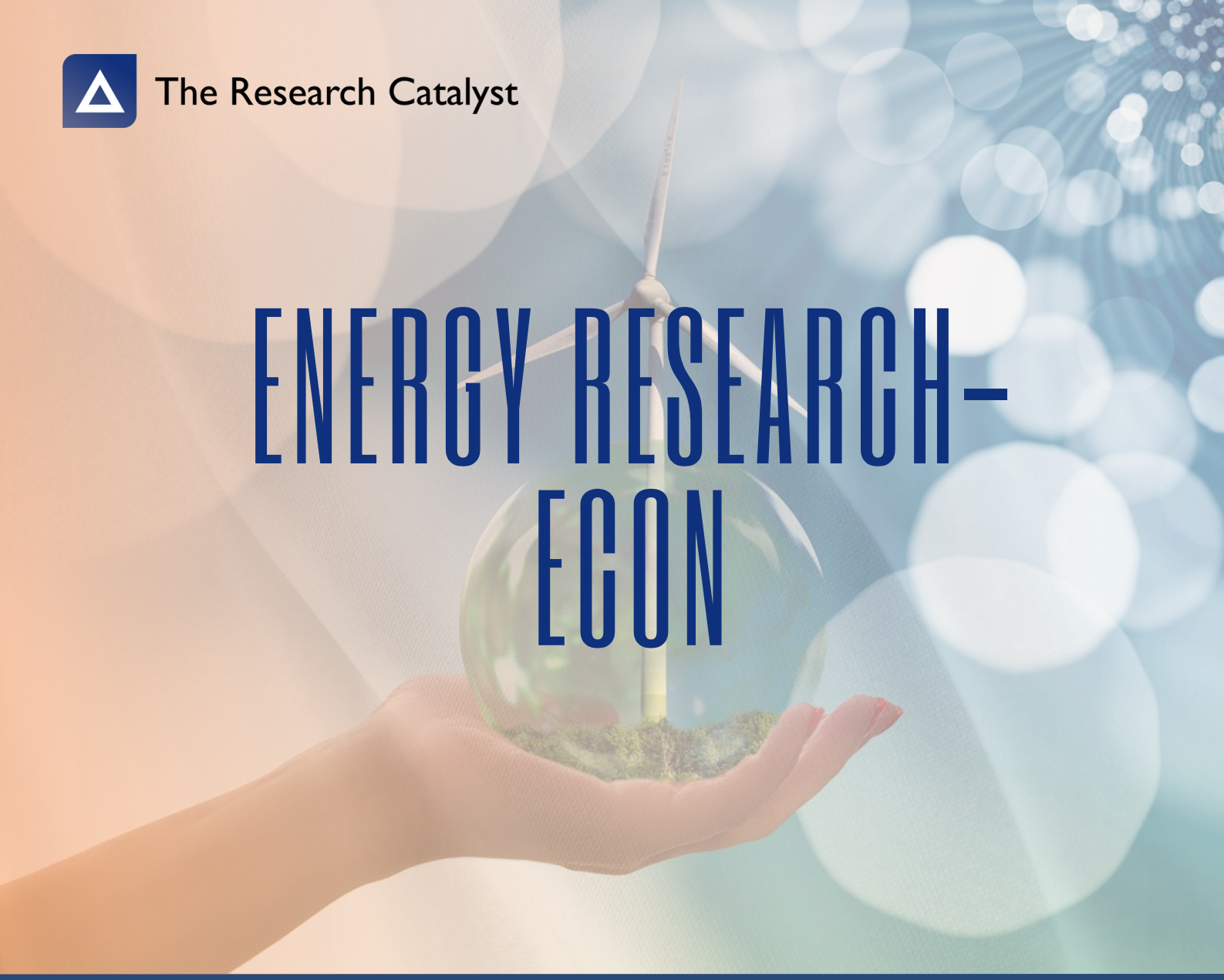
The Research Catalyst



ENERGY RESEARCH-ECON

EnergyRes-eCon 2023

Conference Proceedings Abstract eBook

29 May 2023 (London GMT+1) and 30 May 2023 (Tokyo GMT +9)
Online

e1energies.theresearchcatalyst.com

Acknowledgement

EnergyRes-eCon2023, organized by The Research Catalyst with the support of the Organizing Committee, the administrative team, and the virtual meeting team at 10Times.

The committee and the secretariat would sincerely like to thank all the participants who have taken part in the conference and delivered informative talks about their research work. The time and effort put into making this conference a success by everyone is sincerely acknowledged.

We hope the participants and the rest of the research community benefit from this thought-provoking event. Hoping to meet all the participants in the next edition of the conference soon.

-Sincerely,
The Research Catalyst Team

Content

DAY 1

ENERGY RES-ECON2023

DAY 1

CONTACTLESS MAGNETIC SENSING IN CONDITION MONITORING AND ANOMALY DETECTION FOR SMART GRID: NEW POSSIBILITIES AND ALTERNATIVES

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Our physical and cyber environments are becoming increasingly intertwined with smarter sensing, communication, and data analytics. Our daily livings are indeed surrounded by a wide variety of sensors, IoT connectivity, and edge computing devices, constituting smart grid, smart city, smart transportation, and so on. The availability of sensing devices with measurement, communication, and processing capabilities is providing fine-grained data. Together with multimodal sensory data collection and sensor fusion can result in actionable insights and decisions. This synergy can lead to improved ways and quality of life in what we call smart living.

Magnetism is one of the six energy forms of measurands in sensing. Magnetic sensing plays a critical role in smart living due to various sources of magnetic fields such as magnetic fields from current-carrying wires and permanent magnets which are geometrically determined by Biot-Savart Law and Ampere's Law respectively. These magnetic fields can range from DC to AC, from low frequency to high frequency. Modern civilization heavily relies on electricity which are generated, transmitted, and utilized through

various kinds of transmission medium and electrical machines that are composed of current-carrying conductors, electromagnets, and permanent magnets. As such, magnetic field sensing is an important source of data and thus information for condition monitoring of power generation, transmission, and Distribution.

In this talk, we will discuss the various opportunities and alternatives magnetic field sensing can offer in condition monitoring and anomaly detection in smart grid and smart city. Since it is contactless sensing, its installation is easy and it can be easily retrofitted to the existing plant and equipment. This will minimize cost, avoid wear and tear, and meet stringent reliability requirement. Contactless magnetic sensing can complement the traditional contact measurement techniques and help to overcome the major obstacle towards pervasive sensing due to its scalability.

DAY 1

DECARBONISING PROCESS HEAT IN NEW ZEALAND THROUGH DIGITALIZATION AND SMART PROCESS INTEGRATION

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A seven-year research programme (2020 to 2027) on accelerating the transition to low-emissions solutions in the New Zealand process heat sector is presented. The research is a multi-university collaboration between the University of Waikato, the University of Auckland and Massey University. The research aims to develop Adaptive Energy Digital Twin technology underpinned by process integration and energy system engineering advancements. The technology will be available as open-source tools to assist industry to re-engineer the way they use, convert, provision and store energy for process heat. A top-down study for process heat demand, temperature levels and GHG emissions for all NZ factories is also presented. Preliminary options for new technology deployment and integration of renewable energy are discussed within the NZ context. NZ is uniquely
placed to meet the goal of net zero emissions by 2050 in the process heat sector, with energy efficiency improvement through better control and process integration, future deployment of medium and high temperature heat pumps (up to 200 °C), prudent use of biomass resources for process heat above 200 °C and the smart integration of 100 % renewable electricity with factories and communities.

DAY 1

A ZERO LIQUID DISCHARGE DESALINATION SYSTEM INTEGRATING MULTI-EFFECT DISTILLATION, EVAPORATIVE CRYSTALLIZATION, AND THERMAL VAPOR COMPRESSION

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A seven-year research programme (2020 to 2027) on accelerating the transition to low-emissions solutions in the New Zealand process heat sector is presented. The research is a multi-university collaboration between the University of Waikato, the University of Auckland and Massey University. The research aims to develop Adaptive Energy Digital Twin technology underpinned by process integration and energy system engineering advancements. The technology will be available as open-source tools to assist industry to re-engineer the way they use, convert, provision and store energy for process heat. A top-down study for process heat demand, temperature levels and GHG emissions for all NZ factories is also presented. Preliminary options for new technology deployment and integration of renewable energy are discussed within the NZ context. NZ is uniquely
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HYDROGEN INJECTION IN A DUAL FUEL ENGINE FUELLED WITH LOW-PRESSURE INJECTION OF METHYL ESTER OF THEVETIA PERUVIANA (METP) FOR DIESEL ENGINE MAINTENANCE APPLICATION

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The present work is mapped to scrutinize the consequence of biodiesel and gaseous fuel properties and their impact on compression-ignition (CI) engine combustion and emission Characteristics in single and dual fuel operation. Biodiesel is prepared from a non-edible oil source. Derived from Thevetia peruviana belonging to the plant family of Apocynaceaeis. The fuel has been referred as methyl ester of Thevetia peruviana (METP) and adopted as pilot fuel for the effective Combustion of compressed gaseous fuel of hydrogen. This investigation is an effort to augment. the engine performance of a biodiesel-gaseous fueled diesel engine operated under the varied engine Parameters. Subsequently, the consequences of gas flow rate, injection timing, gas entry type, and manifold gas injection on the modified dual-fuel engine using conventional mechanical fuel injections (CMFIS) for optimum engine performance were investigated. Fuel consumption, CO, UHC, and Smoke formations are spotted to be less, besides higher NOx emissions compared to CMFIS operation. The fuel burning features such as ignition delay, burning interval, and variation of pressure and heat Release rates with crank angle are scrutinized and compared with base fuel. Sustained research in this Direction can convey practical engine technology concerning fuel combinations in the dual fuel mode, Paving the way to alternatives that counter the continued fossil fuel utilization that has detrimental Impacts on the climate.

CULTURAL AND ECONOMIC BARRIERS IN SWITCHING TO CLEAN COOKING ENERGY: DOES WOMEN'S AGENCY MAKE A DIFFERENCE

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The major objective of this study is to identify and analyze cultural and economic barriers to sustained adoption of LPG (liquefied petroleum gas) as the primary clean cooking energy in India and examining underpinning values and norms in socio-technical energy system of the country. In 2016, the Government of India introduced a mega scheme called Ujjwala for clean cooking energy with LPG connects in women's name. This policy, however, experienced limited implementation, but did lead to enhancing women's agency in many areas. Women's agency is defined briefly as their ability to set goals, develop capacities, and act on their defined goals to realize desired outcomes in wellbeing and capabilities. In the case of switching to clean cooking energy, the question can be posed as: as women are the ones who carry out most of the onerous work of collecting and cooking with wood, are they able to make decisions on the adoption of clean cooking fuel, that enhance their agency and the wellbeing of their families? Male-centred cultural and economic norms can be changed by the exercise of women's agency, when (1) women have unmediated asset ownership rights to land, houses, and energy technology; (2) they are organized in groups for earning cash incomes and energy access; (3) they have acquired new knowledge, skills, and finances to acquire and operate new technologies; and (4) women have experienced the effects of policy change addressing gendered norms.

RENEWABLE ENERGY INTEGRATION IN NIGERIA: TECHNOLOGIES, CHALLENGES AND PROSPECTS

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The global drive to decarbonize the power supply chain witnessed an increased investment in Renewable Energy Technologies (RET). Nigeria has huge potentials of Renewable Energy Sources (RES) such as Solar Photovoltaic (PV) and Wind Power (WP). However, power supply situation remains unreliable not only due to inadequacies and over reliance on conventional sources, but the problems associated with the structural and technological changes of RES integration. This paper provides a brief overview from existing reviews and surveys of the technologies, associated problems and mitigation approaches deployed to increase the penetration of RES integration into power system. Four categories of RES integration problems identified from the literature include, Power Quality, Power Flow, Stability and Power Balance. Existing mitigation technologies were then correlated with each category of the problem, thereby resulting in a Problem – Mitigation technology matrix. From the overview, some future prospects of RES and RET as its relate to decarbonizing the Nigerian power supply chain are outlined.

PEROVSKITE SOLAR CELL TECHNOLOGY: DESIGN, MATERIALS AND PROCESS SCALING UP

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In ten years, halide perovskite (PVSK) solar cells reached efficiency comparable to silicon photovoltaic (PV) on small area devices [1]. This promising new PV technology can further be considered for industrial exploitation if the performance gap between laboratory cells and module devices will be nullify. The main scaling up issues are related to module design, interconnection patterning and material/process optimization [2]. During the fabrication process, many defects trap states and grain boundaries can occur [3]. Since the surface is where defects are mainly localized in any kind of solar cell, the PVSK surface passivation is one of the most efficient methods to suppress nonradiative recombination losses, and to improve charge carrier extraction and photovoltage [4,5]. In our work, by performing a design engineering of the module and cells interconnections, exploiting interfacial defects PEAI (phenethylammonium iodide) passivation and optimizing the perovskite composition and the related deposition procedure to avoid the detrimental effect of DMSO (dimethyl sulfoxide) solvent trapping during film formation, we report highly efficient ni-p modules able to achieve an efficiency of 19.1% (reverse scan) with low hysteresis. Moreover, the scaling up losses have been reduced to only 8% (small area cell efficiency was 20.6%) showing the good passivation of defects, the optimal layers homogeneity on small and large area devices and the optimized patterning process by laser technique. Acknowledgments This research was funded by the European Union's Horizon Europe program through a FET Proactive research and innovation action, under grant agreement No. 101084124 (DIAMOND).

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Lithium-ion batteries (LIBs) have revolutionized portable electronics and are now widely used in various applications, including electric vehicles and grid energy storage. This remarkable energy storage technology relies on the movement of lithium ions between the positive (cathode) and negative (anode) electrodes during charge and discharge cycles. The cathode, typically composed of lithium transition metal oxides, plays a crucial role in determining the performance and energy density of LIBs. Researchers have been actively investigating various cathode materials, including layered oxides, spinel structures, and olivine compounds, to improve energy storage capacity, cycling stability, and safety. Additionally, efforts have been directed towards developing advanced anode materials such as silicon, silicon/graphite composites, and lithium metal to enhance the overall performance of LIBs. The development of novel electrolytes, separators, and battery management systems has also contributed to the advancement of LIB technology. Despite significant progress, challenges remain in terms of cost, sustainability, and the need for faster charging and higher energy densities. Future research endeavors focus on addressing these challenges, exploring new materials, and optimizing battery designs to propel the development of safer, more efficient, and environmentally friendly lithium-ion batteries.

During the presentation, I will discuss the advancements and findings in the cathode, anode, and electrolyte additives, highlighting their significance and impact on the performance of lithium-ion batteries. The focus will be on enhancing the energy density, cycling stability, and safety of the batteries through the incorporation of novel materials and additives. Additionally, I will share insights into the challenges faced and the strategies employed in my research to overcome them. The talk aims to provide valuable insights and contribute to the broader understanding of the development of high-performance lithium-ion batteries.

DAY 1

ADVANCED SUSTAINABLE ELECTRODES FOR GREEN HYDROGEN PRODUCTION FROM WATER SPLITTING

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The current challenges faced by societies regarding climate action and the sustainable green energy transition have provided new opportunities for the development of electrochemical energy storage and conversion systems, namely through the use and deployment of renewable energy. Moreover, with the use of critical raw materials and carbon neutrality as major targets, significant progress has been made in recent years toward the development of high-performance electrochemical devices with a view to developing a circular economy.

In such context innovation regarding the potential of water splitting to produce clean, renewable hydrogen also called green, is the focus of this communication. Namely, how developing new Earth-abundant materials to be used in electrodes that efficiently promote the electrochemical conversion of energy from water, still remains a grand challenge to overcome. Some insights on how these technological changes can impact circular economy in the green energy transition will also be provided.

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