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ABSTRACT BOOK

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DAY - 1

PLENARY SESSION

Three Birds, One Stone: E-SAF as Australia's Energy Game-Changer

Florence Lindhaus

Managing Director of NEUMAN & ESSER, Australia

Abstract:

Australian e-SAF for the German Aviation Sector: Bilateral Opportunities for Synthetic Aviation Fuel

This study examines the potential for bilateral trade in synthetic sustainable aviation fuel (e-SAF) between Australia and Germany, addressing a critical challenge in aviation decarbonization. With aviation accounting for significant global emissions, e-SAF offers a promising solution as a drop-in fuel compatible with existing infrastructure.

The EU's ambitious ReFuelEU Aviation regulation mandates 1.2% e-SAF by 2030, rising to 35% by 2050, creating a substantial demand that domestic European production cannot meet. Germany, as the EU's largest kerosene consumer, faces a projected shortfall of over 300,000 tonnes in 2030. Australia emerges as an ideal supplier, possessing exceptional renewable energy resources for green hydrogen production and diverse CO_2 feedstock sources, including 102 million tonnes annually from industrial and biogenic sources.

The analysis reveals that Australia could produce 1-3 million tonnes of e-SAF by 2030 if hydrogen production targets are met, potentially covering the entire EU demand. However, significant barriers exist, including regulatory uncertainty around ReFuelEU's 2027 review, high production costs (€2,135-€8,951 per tonne in 2030 versus €816 for conventional fuel), limited project development, and the need for EU recognition of Australia's Safeguard Mechanism for industrial CO_2 sources.

Key recommendations include providing regulatory certainty, explicitly signalling import needs, establishing financial support mechanisms, developing Australian domestic demand through mandates, ensuring biomass allocation strategies, and accelerating renewable energy infrastructure. This bilateral partnership could enhance energy security, advance decarbonization goals, and position Australia as a global e-SAF leader while helping Germany meet its climate commitments.

Biography:

Florence Lindhaus is Managing Director of NEUMAN & ESSER Australia, where she leads the deployment of integrated hydrogen solutions, including modular PEM electrolysis and advanced compression systems. Previously, she headed the Hydrogen & Energy Cluster at the German-Australian Chamber, establishing the Hydrogen Alliance as a key platform for bilateral collaboration. Drawing on a scientific background and earlier career in biotech across Germany and the USA, Florence now focuses on positioning NEUMAN & ESSER as a market leader in hydrogen infrastructure and system integration for SAF synthesis, green ammonia, DRI, and other power-to-X applications.

Hydrogen demand, a solution to closing supply-side projects

Dr Noel Dunlop,

Energys 9/3-5 Gilda Court, Mulgrave, Vic, 3170

ABSTRACT:

Hydrogen will play a mix in the energy transition, where Australia has gone right and wrong with helping facilitate the sector. With Europe, China, Japan and South Korea having strong projects and uptake, what can Australia do better? In this talk, real-life examples of demand-side projects will be examined. As part of this review, it will be compared to the hydrogen price required versus what can be capable of achieving from supply side projects now and in the future. The talk will cover technologies, regulations, support and economics of where hydrogen can play a part now and into the future.

Biography:

Dr Noel Dunlop has a PhD in Chemical Engineering and Chemistry from the University of Melbourne. He has used this fundamental technical base combined with an MBA in International Management with the skills he developed through experience with large corporates, large family-owned businesses and start-ups in the energy, chemical and industrial sectors for over 25 years. For the past decade, Noel has contributed to the emergence of hydrogen as an energy solution through the founding of Energys Australia. Energys is in a world-leading position as a manufacturer of hydrogen power products in the stationary and marine sectors.

The Changing Role of Hydrogen in Meeting Energy and Decarbonisation Demands

Craig M. Knight

Co-Founder, Horizon Fuel Cell, HYZON Inc and HET Hydrogen, Australia

ABSTRACT:

With more than two decades of technology innovation and commercialisation, Horizon Fuel Cell is one of the stalwarts of the hydrogen sector. Craig has been deeply involved in the constantly evolving set of opportunities for hydrogen technologies.

In recent years, the technology has finally started to reach critical mass in operations and supply chains, and this opens up substantial opportunities not only in the dogged pursuit of decarbonisation but also in addressing burgeoning global power demands.

BIOGRAPHY:

Craig is from Sydney, Australia, and has lived and worked in Asia for much of the last three decades, mostly leading the commercialisation of enabling technologies for the energy transition.

Craig was a co-founder of Horizon Fuel Cell Technologies in 2003, which has become a cornerstone of the hydrogen sector, achieving hard-won success in numerous sectors through continuous innovation.

On the back of substantial Horizon success with commercial vehicle powertrains in the Chinese market, Craig led the carve-out of HYZON Motors as a free-standing "fuel cell trucking" subsidiary in 2020. Craig was temporarily based in the USA for 2.5 years, setting up HYZON, and subsequently returned to Horizon.

Horizon electrolyser subsidiary HET Hydrogen is preparing to launch next-generation AEM technology with 1 and 5MW building blocks, with proprietary materials and designs expected to deliver lower LCOH compared to incumbent electrolyser technologies.

In recent years, Horizon has demonstrated highly reliable MW-scale emission-free power plants. In a world adopting AI technologies at pace, the search for the most viable non-traditional power solutions is underway, and Horizon is well placed to play an important role.

Session: Hydrogen Energy: Production, Storage & Applications

Hydrogen – A pragmatic masterplan to export commencing with and local applications

Robert Saunders

Elecseed, Australia

Abstract

Climate change is not a "con job", and the science cannot be ignored. Various changes, such as weather patterns, are visible more and more, whilst the greenhouse gas emissions since the industrial revolution tell their own story.

However, the use of clean technology and renewable energy sources can slow this trend, and Australia is well placed as a country to be the "supply", with other countries such as the Republic of Korea the "demand"

The use of Hydrogen isn't new, with multiple uses across industrial processes and agriculture being in place for several years. Indeed, with global hydrogen demand increasing, hydrogen production is already a significant industry, but it is almost entirely supplied by coal or gas (often referred to as brown and blue hydrogen, respectively) and is used mostly in oil refining and for the production of fertilisers.

This is changing however, with the ability to produce green hydrogen from renewable energy such as solar Photovoltaics becoming more readily available both technically and

economically. Indeed, without the increase in solar generation infrastructure, the growth potential of green hydrogen would be less attractive.

With this market stability as well as technological developments across renewable equipment such as bi-facial solar panels, the ability to produce green hydrogen is now very much upon us, with countries like Australia, the Middle East, and North America, with land and natural resources, the focus of attention.

However, several export projects (**Hydrogen 1.0**) have failed, and there is market negativity around green hydrogen, some with merit, as we have very much run before we could walk, with large-scale government-backed projects collapsing on a regular basis across the country.

This presentation explores the different uses of Green Hydrogen domestically (**Hydrogen 2,0**) with a focus on Australia, and how, in conjunction with countries like the Republic of Korea, nations can align to develop a strategic partnership for decades to come for the use of Green Hydrogen in multiple applications. This partnership starts with Australian domestic applications to support better economics and knowledge ahead of a renewed attempt at Export.

Plug's Hydrogen Ecosystem

Laurent Van Helden

Director Sales Australia & New Zealand
Plug Power
Australia

Hydrogen Production On-Demand from Biomethane

Shanthi Priya Samudralaa*

a. *Department of Chemical and Biological Engineering, Faculty of Engineering, Monash University, Clayton*
b. *Centre for Advanced Materials and Industrial Chemistry, Applied Chemistry & Environmental Science, School of Science, RMIT University, Australia*

ABSTRACT:

The Australian transportation sector contributes approximately 18% of national greenhouse gas emissions, with road-based transport emissions exceeding the global average. Renewable energy options such as solar fuels and electricity face significant implementation barriers in the transportation sector. Australia is therefore increasingly interested in promoting hydrogen as an automotive fuel, as highlighted by recent developments such as the CSIRO hydrogen

fuel cell car concept. However, onboard hydrogen storage remains a major technical challenge due to the extreme pressures required for containment.

A potential solution is the onboard generation of hydrogen from biomethane, which requires much lower storage pressures and can be readily achieved through catalytic decomposition into hydrogen gas and solid carbon. Furthermore, leveraging Australia's renewable biogas reserves offers an economical and carbon-neutral route for hydrogen production that avoids greenhouse gas emissions. The main challenge in this approach lies in achieving sufficient process intensification to develop a reactor compact enough for onboard use, while maintaining high catalytic activity and resistance to coking.

To advance this concept, this work aims to design and 3D-print a miniaturised catalytic reactor capable of converting biomethane into pure hydrogen gas and solid carbon at elevated temperatures. The study demonstrates the feasibility of on-demand hydrogen generation for fuel cell vehicles, offering a pathway towards cleaner fuel production from Australia's renewable biogas resources. The outcomes of this work could contribute to the development of electric and hybrid vehicles powered by fuel cells that generate their own hydrogen supply, supporting Australia's transition to a low-emission transport future.

Hydrogen ironmaking: A case study in Australia

Alireza Rahbari, Australian National University, Australia

ABSTRACT:

Hydrogen ironmaking is the most mature pathway to eliminate ~7% of global emissions from iron and steel production. However, its economic viability is strongly dependent on renewable energy costs, which contribute over 50% of green steel production costs. Using Australia as a case study and assuming a hydrogen price of ~4 USD/kg, the lowest-cost green steel pathway remains ~55% more expensive than the conventional blast furnace–basic oxygen furnace (BF–BOF) route. When accounting for market ore prices and a carbon price of 90 EUR/tCO2e, green steel approaches cost parity with BF–BOF. GIS-based techno-economic modelling, considering renewable energy availability and location-specific cost factors, indicates that Northern Tasmania can produce hydrogen at costs low enough to support economically competitive green steel production. Further cost reductions are achievable by optimising renewable energy firming to maintain a 95% capacity factor. The competitiveness of Australian green iron in future Chinese markets is strongly driven by local hydrogen production costs, and targeted government support—such as a Hydrogen Production Tax Incentive—could enable substantial export volumes. Scaling green iron production to meet international demand would, however, require vast areas of land for solar and wind energy, posing social license challenges and creating significant demand for infrastructure materials.

Sustaining the Murray-Darling Basin using 24/7 renewable power at an Industrial Scale – Can it be a viable option?

Mark Nesci

NEMA Consulting, Australia

ABSTRACT:

The Murray-Darling Basin (MDB), Australia's largest river system, covers approximately 1,061,000 square kilometres and includes 23 major river valleys, supporting diverse ecosystems, agriculture, and communities. It spans across New South Wales, Victoria, Queensland, South Australia, and the Australian Capital Territory. The MDB has 40% of all Australian farms, supports 9,200 irrigated agriculture businesses and contributes $24 billion to the Australian economy. However, it has faced persistent challenges with water loss, through evaporation, reduced inflows and extraction resulting in a lack of river flow, leading to ecosystem distress. While recent wet periods have provided temporary relief, long-term trends show declining health in many areas, with controversies around the balance between environmental protection and water use for irrigation. The integration of CSP and hydrogen emerges as a promising solution for 24/7 sustainable power at industrial scales, particularly in Australia with its abundant solar resources and off-grid requirements. Utilising a CSP-hydrogen integration and incorporating energy storage, a large pumping system flowing water strategically into the MDB, could deliver environmental benefits to the ecosystems, contribute to the health and wellbeing of these communities, economic growth and agricultural sustainability, improving the livelihoods of the local farmers, who are a major contributor to the country's food bowl. The author will explore and present the viability and possibilities of such a project, as both CSP and hydrogen are emerging players in the renewable sector and part of the overall energy mix, for long-term sustainable power.

Resilient Green Hydrogen Production: Managing Life Cycle Economics and Uncertainty

Mahshid Zaresharif

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ABSTRACT:

Green hydrogen production is a critical enabler of the energy transition, but its success depends on more than simple Capex terms or technology datasheet efficiency, it requires a clear understanding of life cycle economics and operational resilience. This presentation highlights why life cycle cost awareness is essential, focusing on the often-overlooked elements that shape total cost of ownership. Beyond CAPEX and OPEX, this presentation explore the impact of

service strategies, reliability considerations, and maintenance planning, including how periodic O&M setups and hidden inefficiencies can influence long-term performance. Examples will illustrate challenges such as unknown operational cost and unreliability, safety-related uncertainties, and unexpected service requirements, which can significantly affect project economics if not anticipated. By recognizing these factors early, stakeholders can better manage uncertainty and design resilient green hydrogen systems that deliver sustainable value.

Unlocking Australia–Europe Clean Fuel Trade: From Strategy to Delivery

Miro Moss

Haskoning Australia Pty Ltd, Level 15, 99 Mount Street, North Sydney NSW 2060, Australia

Abstract:

As global demand for renewable fuels accelerates, Australia is uniquely positioned to supply Europe and other international markets. This keynote explores the opportunities and challenges of clean fuel trade, highlighting how strategic planning, regulatory frameworks, and commercial considerations intersect to enable successful project delivery. Drawing on extensive experience advising clients across the full project lifecycle, from feasibility studies and approvals to engineering and construction, Miro demonstrates how consultancy expertise can accelerate the development and commercialisation of renewable fuels. The talk also examines international market mechanisms and safeguard instruments, including H2Global, RFNBO certification, CBAM, and the Guarantee of Origin certificate, which underpin the emerging global clean fuel economy. Attendees will gain insights into how policy, market, and technical factors converge to shape future directions in renewable energy fuels, and how organisations can position themselves to capture these opportunities effectively.

Hydrogen storage: current trends and future challenges

Melinda Krebsz

[a]*Research School of Chemistry, College of Science and Medicine, The Australian National University, Canberra, ACT 2601, Australia*

Abstract:

One of the key enabling energy transition technologies to reach net-zero goals is hydrogen storage. There is a high industrial applications, and society demands diverse energy storage technologies from laboratory to large-scale applications.[1] Both existing and current developments in hydrogen storage technologies need to be discussed in terms of policy, market and technological readiness perspectives. From the materials perspective, further improvements are needed regarding the improvement of materials' hydrogen storage capacity

and hydrogenation/dehydrogenation properties to provide an environmentally sustainable and cost-effective large-scale storage technology.[2] Intended applications should be also discussed to understand the industrial and end-user's needs for on-board mobile or stationary applications. Regulations and market needs for hydrogen storage are different due to the varied landscape, governmental regulations, as well as social needs; these are important to be considered for further technological developments. Large-scale storage technologies are maturing in underground storage facilities, while liquid hydrogen carriers are emerging for mobile applications.

Hydrogen as a transition fuel for power generation in Queensland

Lucas Skoufa, Griffith University, Australia

Abstract:

Gas turbines will provide important firming capacity in the energy transition facing Australia's National Electricity Market (NEM). Currently, gas turbines utilise natural gas (methane) as the fuel of choice. Given there is a decarbonisation goal for the electricity grid, the use of hydrogen as a fuel is shown to be viable, noting some gas turbines are already able to burn an 80% hydrogen / 20% natural gas fuel mix. Hedging to meet contracted volume obligations is expected to maintain profitability with low pool prices due to variable renewable energy (VRE) technologies. The primary contract evaluated was a \$300/MWh cap contract for various fuel mixes of 100% natural gas to 100% hydrogen. Results indicate that hydrogen gas turbines are financially viable in an electricity market with increasing VRE with a range of weather conditions. The sensitivity of a carbon price is also considered.

Key words: peaking gas turbines, hydrogen, NPV, financial viability, sensitivity analysis, carbon price

Highlights:

- OCGT are financially feasible across all fuel blend combinations considered.
- 100% H_2 turbines with unsubsidised H_2 fuel costs were financially feasible.
- 100% CH_4 turbines with a carbon price were also financially feasible.
- Subsidising H_2 fuel costs enhances project economics of 100% H_2 turbines.
- Poor VRE conditions improve project economics for all OCGT

Experimental Assessment of a 1kW High Temperature PEM Fuel Cell Stack Performance for Commercial Applications

Susanta K. Das*
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Centre for Fuel Cell Systems and Powertrain Integration, Kettering University
1700 University Avenue, Flint, Michigan 48504, United States of America.

Abstract:

In this investigation, a 1 kW high-temperature proton exchange membrane (HTPEM) fuel cell stack is designed and built with an individual active cell area of 440cm2. Enhanced electrochemical kinetics, useful waste heat recovery, and acceptance of higher CO-rich reformate hydrogen make the HTPEM fuel cell a viable candidate for useful commercial applications such as auxiliary power unit (APU). The use of existing refuelling infrastructure and rapid deployment of this new technology to combat global warming and reduction of environmental pollution, it is preferable to use CO-rich reformate in a PEM fuel cell stack to produce the required useful electric power easily. The purpose of this study is to assess the HTPEM fuel cell stack performance experimentally at different operating conditions for possible commercial applications. Both individual cell as well as stack performance in terms of current-voltage characteristics has been experimentally measured at different temperatures with fixed anode and cathode stoichiometry to assess the impact of various air-fuel ratios on this 1kW stack. To develop and validate the 3D fuel cell models to understand and optimise the operation of individual cells as well as the HTPEM fuel cell stack, experimental data of this type is required for further improvement of stack design and durable performance. The experimental results showed variations and sensitivities in current-voltage characteristics quantitatively at different temperatures with various anode and cathode stoichiometries. The results are very helpful to understand the cell and stack performance in terms of current-voltage characteristics while fed with CO-rich reformate hydrogen in the anode fuel stream.

Towards Computational Discovery of Z-scheme Heterostructures as Highly Efficient Photocatalysts for Hydrogen Production from Water Splitting

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b. *Department of Physics, Faculty of Science and Engineering, University of Nusa Cendana, 85001, Kupang, Indonesia*

Abstract:

Photocatalytic water splitting facilitates solar-driven production of H2 and O2, as well as H2O2 for some selective catalysts. Z-scheme heterostructures have great potential as photocatalysts for water splitting. One of the main challenges in designing these heterostructures is how to distinguish between the Z-scheme and the traditional type-II mechanisms. This can be done experimentally, but it is very inefficient for discovering new

materials as photocatalysts. Therefore, computational prediction is very important for accelerating the discovery of new Z-scheme heterostructures as highly efficient photocatalysts for water splitting. Unfortunately, there is currently no well-established computational method to differentiate between type-II and the Z-scheme. Most previous papers only use built-in electric field analysis, which has been experimentally proven to be inaccurate. Therefore, we propose a new, more comprehensive and accurate method than the usual methods to distinguish between these two mechanisms. This method not only relies on charge transfer due to the built-in electric field, as used in most previous studies, but also incorporates interactions between the catalyst surface and water and other intermediates. Consequently, only materials that are predicted to possess the Z-scheme mechanism will be synthesised experimentally and applied as photocatalysts for water splitting to generate hydrogen.

Day- 2

Session: Renewable Energy Systems and Environmental Impact

Development of solar photovoltaic and thermal module for heat pump applications

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Abstract:

A novel roll-bond cooling panel integrated solar silicon photovoltaic thermal (PVT) module has been developed. The cooling panel replaces the back plate of the PV module and can harvest the waste heat from the solar cell. This is helpful for removing the temperature effect of the solar cell and improving the power generation. The challenge lies in solving the efficiency, uniformity, and reliability issues that arise during waste heat recovery. The integrated solar PVT module consists of a roll-bond cooling panel and crystalline silicon PV cells, and couples it with a heat pump system to meet the heating temperature requirements. This achieves both cooling and efficiency improvements of the PV module, as well as waste heat recovery, while significantly increasing power generation and improving the quality of the output thermal energy. The results indicated that the PVT module, compared to traditional PV modules, increased power generation by 13.3%, with a heat gain factor exceeding 1.1. At the same time, the un-uniformity of the PVT module's operating temperature is controlled within 5 °C, and the reduction of the operating temperature reaches over 30 °C. The supply hot water temperature is 55 °C, the average COP of the system can reach 6.7, which is 67.5% higher than that of the air-source heat pump system, and the overall solar utilisation efficiency is above 80%, achieving high-efficiency and stable cogeneration process.

Solar farms – the impact of wind load on design considerations and layouts

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Abstract:

Wind loading is a critical design factor for solar farms, including both photovoltaic and heliostat fields, influencing structural resilience, cost effectiveness, and operational reliability. This presentation summarises over 15 years of research at the University of Adelaide, aimed

at improving the aerodynamic performance and durability of large-scale solar installations conducted in collaboration with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australian National University (ANU) and Queensland University of Technology (QUT) as part of the Australian Solar Thermal Research Institute (ASTRI), and National Renewable Energy Laboratory (NREL) and Sandia National Laboratory as part of Heliostat Consortium (HelioCon).

Accurate wind tunnel testing requires dynamic similarity between model and full-scale conditions. Based on the results of experiments, it was shown that to achieve validated results, it is necessary to make sure that the range of reduced frequency of 0.01-1 of the turbulence spectra must be correctly modelled, as they contribute the most to the unsteady wind loads. The suitable geometric scaling ratio of the structure can be determined based on the scaling ratio for which the turbulence spectrum as a function of reduced frequency is the closest match to that at full-scale (Jafari et al. 2019). In addition, detailed wind tunnel experiments were conducted to measure the mean and peak wind load coefficients at different turbulence levels. It was shown that both mean and peak wind load coefficients are proportional to both temporal and spatial variation of wind velocity, represented by wind turbulence intensity and integral length scale, respectively. (Emes et al. 2019, 2021).

Investigations into panel geometry revealed that increasing aspect ratio substantially amplifies hinge and overturning moments (Bakhshipour et al., 2024), while lift coefficients scale almost linearly with height. It was also shown that ground clearance has a limited influence on drag but affects moment coefficients. Experiments on facet gaps showed little change or slight increases in wind load (Marano et al., 2024).

Several methods, including the application of perimeter wire mesh fences and edge-mounted large eddy breakup devices, were tested in the University of Adelaide wind tunnel. The results show that while the application of perimeter fences has a negligible impact on the forces on panels, the application of edge-mounted devices can present potential to reduce forces if designed properly and hence can reduce the manufacturing costs of farms.

An Innovative Two-phase Anaerobic Digestion Process for Bioenergy Production from Food Waste

Jonathan W.C. Wong[a]

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Abstract:

Anaerobic digestion (AD) is a sustainable alternative, enabling the conversion of food waste (FW) into valuable bio-products and energy. However, under high-solids conditions, lactate

accumulation is frequently observed in FW digestion, presenting a challenge to the AD process. Our research presented a breakthrough two-phase AD system integrating gas diversion and metabolic pathway regulation to enhance carbon conversion and energy recovery. By separating hydrolysis-acidogenesis from methanogenesis and transferring acidogenic H_2 to the methanogenic phase, the system facilitates in-situ carbon capture and utilisation via enhanced hydrogenotrophic methanogenesis. To further improve the acidogenesis, exogenous inoculation of *Megasphaera elsdenii* and acetate supplementation were employed to redirect fermentation from lactate-dominated to butyrate-type. This proof-of-concept strategy enhanced organic removal by 16–35%, increased H_2 and butyrate yields by over 60%, and improved methane production by 25%, resulting in a 1.33-fold increase in overall carbon conversion efficiency as compared to the control. Economically, the acidogenic H_2 enhancement and reuse strategy eliminates the need for external H_2 supplementation to minimise carbon loss, thereby reducing operational costs and increasing methane profit. Overall, the proposed two-phase AD system with gas diversion achieved a 6–18% increase in net income (by estimated food waste treatment: 100t/d) compared to conventional single-phase FW treatment. By integrating gas diversion with targeted metabolic engineering, the system realises the full potential of two-phase AD, propelling waste-to-energy technologies toward carbon neutrality and circular economy goals for food waste management.

Experimental Evaluation of a Solar-Powered Electrostatic Precipitator System for Reduction of Environmental Pollution and Improved Public Health

Susanta K. Das*

Department of Mechanical Engineering

Renewable Energy Laboratory, Kettering University

1700 University Avenue, Flint, Michigan 48504, United States of America.

Abstract:

In this study, a 2-stage solar-powered electrostatic precipitator (ESP) system is designed and built for experimental evaluation of its performance to clean the particulate matter from the air. Particulate matter suspended in the air due to wildfire or industrial waste, such as coal dust emerging from coal power plants, utility boilers, cement kilns, *etc.,* creates environmental pollution, causing public health concerns in major cities all over the world. An ESP is a particulate matter collection device that uses electrical forces to move the suspended particulate matter out of the flowing gas stream by forcing it to pass through a corona, a region in which gaseous ions flow, resulting in the charged particulate matter depositing onto collector plates from which it can be removed easily. The primary objectives of designing and testing a 2-stage ESP are to optimise the operating conditions, such as the wire-to-plate spacing, the air velocity through the ESP, etc., to increase efficiency. Our approach is to

develop an efficient unit that could be integrated with existing buildings to purify the air in the living areas, business office spaces and surrounding areas to improve public health and reduce environmental pollution. The experimental results showed that there exists an optimum condition in which particles can be deposited on the collection plates readily. The experimental results were compared with existing theories, and it seems the ESP system can be used in numerous applications, such as cleaning of indoor air in houses, big office complexes, hospitals, and food processing factories.

Latest developments in printed solar, a sustainable energy generation technology

B Vaughan[ab]*

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[b] *Newcastle Hub, Materials Node, Australian National Fabrication Facility (ANFF): NIER A409, University of Newcastle, Callaghan, NSW, 2308*

Abstract:

Printed solar, based on organic photovoltaic modules, is a sustainable energy generation technology that is poised for commercialisation. As a lightweight, flexible solar technology, it is currently being used in unique applications such as the live music industry. Produced using roll-to-roll coating techniques that have the potential for significant scale, printed solar is also highly recyclable, a key point of difference from silicon photovoltaics.

This talk will give an overview of the journey of printed solar, from small-scale, lab-based experiments through to now deploying in real-world scenarios, such as supporting Coldplay’s “Music of the Spheres” world tour. The future of printed solar will also be discussed, looking at the potential for impact in the live music and disaster relief industries.

Along with the discussion of the technology itself, this talk will also reflect on the environment within which these types of developments can be supported, and the role that entities such as the Australian National Fabrication Facility (ANFF) can play in translating energy innovations from the laboratory to industry.

Solar pumps for the extraction of groundwater: The need for life cycle design (LCD)

W. John Dartnall[a.] Presenting / Corresponding Author, [b]Alistair Sproul Co-Author

[a.] *University of Technology, Sydney: 15 Broadway, Ultimo, NSW, 2007, Australia*

[b.] *University of New South Wales: Sydney, NSW, 2033, Australia*

Abstract:

A little recognised problem of solar pumps relates to the variability (diurnal, cloud-related and seasonal) of incoming solar radiation. We have pointed out in our presentation to WREC22* that this variation has led to unnecessarily poor daily water delivery by submersible solar pumps that dominate the market. We pointed out that the efficiency of these submersible solar pumps varies with the variable solar input. We have shown, both in the field and by comprehensive analysis, that a well-designed piston solar pump will approximately double the daily water delivery of a submersible pump for a given situation (head, flowrate and PV array size). This means that the entire solar pump system (from array to motor, control system, pump, wiring…) can be minimized for a given output. Thus, a substantial reduction in material can be achieved for a given output. In addition, the submersible solar pumps are not well designed for ongoing maintenance but rather designed for disposal after a hopefully trouble-free life of, say 12 years, when installed in a suitably constructed well that produces clean water. We contend that the well-designed piston pump significantly reduces material footprint, is more robust against poor water well construction and poor water quality, is readily maintainable, thereby extending pumping-system life well beyond 12 years, and is appropriate for local manufacture. These characteristics all support the Life Cycle Design (LCD) strategy.

*World Renewable Energy Conference, Nov 2022, Perth, WA.

Next-Generation Bioelectrochemical Systems for High-Efficiency Methanogenesis of Marine Macroalgae

Buntora Pasaribu

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[b]*Shallow Coastal and Aquatic Research Forensic (SCARF) Laboratory, Faculty of Fishery and Marine Science, Universitas Padjadjaran, Bandung 40600, Indonesia*

[b]*TORGAS Laboratory, Bandung 40600, Indonesia*

Abstract:

Marine macroalgae represent a promising renewable resource for sustainable bioenergy production. This study explores the potential of next-generation bioelectrochemical anaerobic digestion systems to enhance methanogenesis using marine-based biomaterials, including seaweed, water hyacinth, and cow manure. An Autonomous Portable TORGAS unit was employed to optimize the anaerobic digestion process through integrated safety sensors and controlled heat generation, allowing stable operation across mesophilic and thermophilic

temperature ranges. The system facilitated efficient microbial degradation of organic substrates, resulting in biogas with 50–70% methane content, alongside minor fractions of CO_2, O_2, and H_2S. The findings demonstrate the feasibility and efficiency of combining marine biomaterials with advanced anaerobic digestion technologies, highlighting their potential in next-generation bioenergy systems.

Circular Solar: Extending Module Lifecycles Through Preventative Maintenance and Responsible Asset Management

Andrew Barrington

Solar Shine Australia, Australia

Abstract:

The circular economy is often framed around recycling, but in the solar industry, true circularity begins long before end-of-life. Every solar panel that fails prematurely represents not only a lost energy asset but also wasted embodied carbon and materials.

Drawing on field experience from large-scale solar maintenance programs in Australia—including proactive servicing for government and commercial portfolios—this session introduces “Circular Solar,” a framework for embedding lifecycle stewardship into sustainability strategies. It demonstrates how data-driven maintenance, inspection, and simple interventions such as cleaning and bird-proofing can delay decommissioning by years, protect asset performance, and drastically reduce solar waste volumes heading to landfill.

Delegates will gain a practical understanding of how preventative maintenance can be treated as a climate-positive action and integrated into procurement, ESG reporting, and circular-economy policy.

Advancing HEVs Lubrication Through Sustainable Biolubricant Development from Indigenous Australian Feedstocks

Muhammad Ali Ijaz Malik

Faculty of Engineering and IT, University of Technology Sydney, Australia

Supervisor: Prof.Dr. Md Abul Kalam

Abstract:

Energy security is a primary concern for achieving a sustainable environment. To support sustainable energy development, biomass waste products conversion to bio-lubricants has been scientifically effective due to their lubricating properties. Millions of tons of biomass waste are discarded daily in major cities worldwide, and this waste should be converted into energy products. Environmental sustainability highlights the necessity of finding alternatives to petroleum resources. Lubricants play a crucial role in enhancing energy-saving performance, so it's essential to consider the tribological aspects for optimising machinery efficiency. Hybrid electric vehicles (HEVs) are becoming increasingly viable options due to their higher fuel economy and lower emissions. The current study aims to thoroughly investigate the role of bio-lubricants in promoting environmental sustainability, with a primary focus on using local indigenous Australian feedstocks for bio-lubricant production. The cottonseed oil, and by-products of canola oil refining, specifically canola oil deodoriser distillate, have been selected as the primary feedstocks for bio-lubricant and biofuel synthesis. The resulting bio-lubricants will undergo a series of experimental tests, including tribological testing, rheological testing, physicochemical testing, and Fourier transform infrared spectroscopy. Moreover, the current study highlights integrated utilisation pathways to maximise natural resource utilisation and reduce dependence on conventional fossil fuels, thereby substantiating zero-carbon targets and boosting the economy through value-added products derived from agricultural residues. Future research should focus on advanced processing techniques, real-time hybrid engine testing, techno-economic and lifecycle assessments, and policy frameworks to accelerate the broader global application and commercialisation of these technologies.

Session: Policy, Economics, and Commercialisation

Western Australia's Energy Transformation: A Strategic Shift in the SWIS

Noel Ryan

Assistant Coordinator, Energy Policy WA, the Department of Energy and Economic Diversification.

Abstract:

The energy transition is progressing rapidly within one of the world's most geographically isolated power systems — the South West Interconnected System (SWIS). With the planned retirement of all State-owned coal-fired generation, Western Australia is undertaking a significant transformation of its main electricity grid, utilising innovative and locally tailored solutions. Western Australia holds one of the highest rates of rooftop solar adoption globally. This presents both operational challenges and a unique opportunity for households to actively contribute to the State's energy future. Through a strategic combination of distributed energy resources (DER), large-scale infrastructure, and forward-looking market reforms, the SWIS is evolving into a more affordable, sustainable, and reliable energy system for all Western Australians.

Cost optimisation of Germany's Energy system: Generation, Storage and Transport

Paul Grunow

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Abstract:

This discussion paper uses time-series-based computer simulations to compare *centralised* and *decentralised storage* schemes, i.e. stand-alone large-scale storage systems in the power grid and storage on co-location to renewable power systems, with regard to overall system costs. This aspect has not yet been considered as a downstream aspect in previous simulations, e.g. [1] and its follow-ups.

A complete switch to battery-powered vehicles (50 million) and electric heat pumps (21 million) in Germany by 2045 is assumed. The latter are operated as hybrids with peak-load hydrogen burners or are more efficient in combination with fuel cells during power shortages in winter; see details in [2]. In order to reduce the need for expansion of the power grid, Germany's hydrogen core network is used for hydrogen collection as well, i.e. it is also taking part in power storage and energy transport. During periods of low wind and solar power generation in winter, the hydrogen is converted back into electricity in a decentralised manner to meet peak heating demand and make gas power plants obsolete.

In terms of cost optimisation, decentralised hydrogen storage proves to be the most cost-effective renewable energy system:

Fig 1: Costs for generation, storage and transport in four cost-optimal mixes in Germany 2045

Additionally, the paper addresses the ratio of inverter capacity to electrolysis capacity to installed plant capacity and curtailment in cost optimization. It also compares the shares of battery and hydrogen storage.

[1] P. Sterchle et al. Wege Zum Klimaneutralen Energiesystem, Fraunhofer ISE 2020,

https://www.fvee.de/wp-content/uploads/2022/01/FpP_2020-02-20_Fraunhofer-ISE-Wege-zueinem-klimaneutralen-Energiesystem.pdf

[2] P. Grunow, Energies 2022, 15(8), 2820; https://doi.org/10.3390/en15082820

Clean Energy For And From Agriculture

Kudang Boro Seminar

Department of Mechanical & Biosystem Engineering

IPB University, Indonesia

Abstract:

Agriculture is a food production activity that will continue to thrive until the end of the world. However, it absolutely requires energy. Energy is crucial for nearly every aspect of the agricultural value chain. Globally, the food sector consumes 30 per cent of the total energy supply and produces 20 per cent of global emissions. Therefore, energy must continue to be provided intelligently and sustainably. Agriculture that utilises energy intelligently and precisely is called "energy-smart and precision agriculture" The world's most critical and challenging issue is how to ensure sufficient food and energy availability for human life throughout time. Meanwhile, the population continues to grow rapidly, which suggests and demands that humans strive more intelligently to increase agricultural productivity in line with future population growth rates. The understanding, research, and application of agriculture as a food producer have long existed and continue to evolve. It is important to note that agriculture not only produces food but also generates energy for human survival and agriculture itself. The exploration and development of science and technology to utilise agriculture as an energy producer remains very limited compared to its role as a food and feed producer.

Uncontrolled population growth has placed tremendous pressure on energy resources, and the world is on the brink of an energy crisis. Therefore, scientists are seeking renewable natural

resources to meet energy needs and as an alternative to fossil fuels. Biomass, particularly agricultural biomass, is a viable alternative to address this issue. Not only is it abundantly available worldwide, but it also has the potential to fuel the next generation. Biomass energy sources are included in renewable energy sources (SRE), along with wind, hydro, and solar energy. Included in this group of biomass fuels are agricultural and forest residues, municipal solid waste (MSW), animal (cattle) waste, industrial residues, organic materials, and plant biomass products. Bioethanol, biodiesel, and biogas are alternatives to petroleum, diesel, and natural gas, respectively.

A larger and more relevant challenge is how to meet the increasing future demand for food and energy, especially when water and land availability will be limited. Energy crop production systems differ significantly in their environmental impacts. The use of high-input food crops for liquid transportation fuels (first-generation biofuels) needs to be phased out and replaced with the use of low-input crop residues and perennial crops (second-generation/advanced biofuels) with multiple environmental benefits. The emphasis must shift from the 'food or fuel' dilemma to providing solutions to the challenge of how to secure the increasing demand for food and energy in the future. This paper will discuss the ways and research directions on how agriculture to produce not only food and feed but also clean and renewable energy for sustainable agriculture and human survival.

Advanced Project Management: Optimizing Renewable Energy Portfolios through AI and ESG Integration

Javier Mauricio León
Proyecta Consulting, Colombia

Abstract:
This presentation builds upon the analytical framework shared in the ACIPET 2025 Congress, expanding its application to renewable projects such as solar, wind, and hydrogen initiatives. It explores how artificial intelligence—through neural networks, fuzzy logic, and genetic algorithms—can enhance investment prioritisation, performance prediction, and risk-adjusted decision-making across the renewable energy value chain.

A legal, theoretical, and practical perspective on prosumers as entities of the energy transition in Poland.

Prof. UAM dr hab. Aneta Suchoń
Faculty of Law and Administration; Adam Mickiewicz University in Poznań, Poland

Abstract:
For several years now, there has been a growing interest in Poland in electricity from renewable energy sources for personal use in the prosumer model. Currently, there are over 1.5 million

prosumers. The presentation will begin with an overview of the legal conditions governing renewable energy sources in Poland, as well as the concepts of energy transition, decentralised energy, energy security, and citizen energy. It will then focus on the concept of prosumers in light of the Polish Renewable Energy Sources Act. First and foremost, the condition is the generation of electricity exclusively from renewable energy sources for own use in a micro-installation. An entrepreneur can also be a prosumer if RES is not the subject of their predominant economic activity. The next part will refer to the concept of prosumer in the light of Directive (EU) 2018/2001 of the European Parliament and of the Council of December 11, 2018, on the promotion of the use of energy from renewable sources (hereinafter: RED II Directive).

The part of the paper will also concern financial support for RES investments from EU and national funds, and the principles of energy settlement. Reference will be made to photovoltaics and energy storage facilities, which have also become a mandatory component of investments, e.g., co-financed from public funds. An important aspect is the billing system. After the closure of the discount system for new prosumers in 2022 and its replacement with net billing, investments in prosumer energy have slowed down significantly. Reference will also be made to the adoption of collective and virtual prosumers.

In conclusion, the author stated that in Poland, there is great interest among individuals and entrepreneurs in generating electricity exclusively from renewable energy sources and storing it. This is an important issue in terms of development, as prosumers contribute to the development of citizen energy and the energy transition. Polish and EU legislators are trying to introduce regulations that encourage investment in renewable energy sources. Currently, changes are needed in the area of renewable energy accounting by Prosumers, as it is not very beneficial for them. These changes should also take place at the EU level.

Reality bites – the truth of the electricity sector transition

Azadeh Keshavarzmohammadian,

477 Collins Street, Melbourne, Vic 3000

Abstract:
The electricity sector is undergoing a system-wide transition that will require rapid and significant investment in a range of transmission, firming, generation and storage technologies to ensure the market remains competitive and delivers the best outcomes for energy consumers and broader stakeholders.

Despite many successes in progressing towards Australia’s clean energy ambitions, significant challenges remain that need to be navigated by market participants and stakeholders to achieve set targets:

- **Investment** – is proving challenging due to increased wholesale price volatility, economic and physical curtailments, expiration or market size reduction of alternative revenue streams (Large-Scale Generation Certificate or ancillary markets) and uncertainty in how the market size and profile will evolve toward the future.

- **Planning** – needs consideration of inter-sectoral dynamics and commercial viability. A central planning approach is required due to increased interrelation between demand and supply through distributed/consumer energy resources; designed solutions must factor in local conditions and resources.
- **Customer and community** – Any designed solutions/policies/mechanisms must consider the impact on markets, end-customers and community stakeholders. Efficient community engagement is a crucial step that needs to be actioned early in the process to achieve timely outcomes.
- **Skill and Jobs** – Additional skills need to be planned and developed for unlocking the new opportunities for workers of changing industries, with consideration of local resources/opportunities and constraints to meet local needs.

In this presentation, we provide insights into these challenges, which are based on our first-hand engagement with private and government clients in assisting with their complex problems.

The role of research and innovation in unlocking economic decarbonisation pathways for heavy industries.

Dr Ali Bahramzadeh

Net Zero Economy Authority, Australian Government

Abstract:
Australia's heavy industries, including steel, alumina, cement, chemicals and liquid fuels, are among the most challenging sectors to decarbonise. While renewable energy costs have fallen dramatically over the past decade, driven by innovation across technology, manufacturing, supply chains and system integration, the same level of cost reduction has not yet been achieved in industrial processes that require high-temperature heat, continuous energy, chemical reduction agents and zero-carbon feedstocks such as hydrogen. As a result, industrial decarbonisation remains primarily an economic challenge.

This presentation will explore the central role of research and innovation in closing this cost gap. It will highlight how innovation across the entire value chain can drive down costs and unlock the feasibility of green metals, green ammonia, low-carbon liquid fuels and advanced battery materials. The presentation will also examine the regional dimension of industrial decarbonisation. Each major fossil-fuel region in Australia has a different industrial base, workforce profile and renewable resource advantage. Australia's future industrial pathways will therefore emerge differently across regions, shaped by comparative advantage, infrastructure readiness and local capability.

The Net Zero Economy Authority (NZEA) plays a critical role in this transition by coordinating investment, infrastructure planning, community engagement and regional economic analysis to ensure that innovation can scale from the pilot projects to real industrial systems. Ultimately, heavy-industry decarbonisation will depend on innovation that makes solutions affordable,

industry that makes them investable, and regions that make them real. This talk will outline how Australia can bring these elements together to build its next generation of globally competitive, low-carbon industries.

JA Solar's Next Generation TOPCon Technology for Solar Modules

Ankit Tyagi

JA Solar, Australia

Global Challenges and Deployment Landscape of CCS for Achieving Net-Zero

Minhee Son* [a]

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Abstract:
To achieve net-zero as a low-carbon strategy, the adoption of CCS remains indispensable, particularly for hard-to-abate sectors where alternative mitigation options are limited. According to the IEA, more than 300 CCS projects are currently in operation or under development worldwide, reflecting growing international recognition of the technology's strategic importance. Despite this expansion, CCS continues to encounter significant technical, financial and governance-related challenges. Many projects face delays due to high capital costs, regulatory uncertainty and difficulties in securing long-term storage sites. Geographic constraints also play a crucial role, as suitable geological formations for CO_2 storage are unevenly distributed. This means that only a limited number of countries can deploy CCS at scale, creating both opportunities and dependencies within the global carbon management landscape. In certain regions, the development of CCS value chains has fostered new forms of cross-border cooperation, infrastructure sharing and industrial interdependence, while also revealing potential vulnerabilities linked to regional disparities. Against this backdrop, this study offers a comprehensive overview of global CCS deployment and examines the key obstacles encountered across existing projects. It synthesises technical, economic and governance-related issues to provide a clearer understanding of the conditions under which CCS can effectively support long-term decarbonisation pathways.

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