Ammonia = Hydrogen 2.0

"Building an energy export industry using Green Ammonia"

Ian Wark Theatre, CSIRO, Clayton, Victoria, Australia
22nd and 23rd of August, 2019

Presented by the Australian Chapter of the Ammonia Energy Association

AMMONIA ENERGY ASSOCIATION

We hope you enjoy the conference!

$NH_3 = H_2$ 2.0 Organising Committee

John Mott	Chair - AEA Australia
Doug MacFarlane	Monash University
Sarb Giddley	CSIRO
Brett Cooper	Renewable Hydrogen
Vinod Patel	Yara Pilbara Fertilisers
Jacinta Bakker	Monash University
Gary Paul	CSIRO

Program

Day 1 - THURSDAY 22nd AUGUST

09.30am – Registration and Morning Tea
10.00am – Welcome to country, Mr John Mott
10.05am – Opening Address, The Hon. Lily D'Ambrosio
10.15am – Keynote Speaker, Mr Shigeru Muraki (Green Ammonia Consortium and Tokyo Gas)

11.00am – 12.30pm Session 1
- 1.1 11:00am - Mr John Bogild Hansen (Haldor Topsoe)
- 1.2 11:20am - Prof Doug MacFarlane (Monash University)
- 1.3 11:40am - Mr Martin Hablutzel (Siemens)
- 12:00pm - Q&A Panel Session

12.30pm – Lunch break

13.15pm – 3.00 pm Session 2
- 2.1 13:15pm - Who is the AEA?
- 2.2 13:30pm - Dr David Harris (CSIRO)
- 2.3 13.50pm - Mr Chris Rijksen (Yara Pilbara Fertilisers)
- 2.4 14:10pm - Dr Charlotte Rouse (Australian Renewable Energy Agency)
- 14:30pm - Q&A Panel Session

15.00pm – Afternoon tea break

15.30pm – 17.00pm Session 3
- 3.1 15:30pm - Mr Lars Bryndum (MAN Energy Solutions SE)
- 3.2 15:50pm - Prof Dongke Zhang (University of Western Australia)
- 3.3 16:10pm - Mr Koh Eng Kiong (Nanyan Technological University)
- 3.4 16:30pm - Q&A Panel Session

17.00pm – 18:00pm Poster Session

18.15pm – 21.00pm Conference Dinner

Day 2 - FRIDAY 23rd AUGUST

08.30am – 10.30am Session 4
- 4.1 08:30am - Ms Claire Johnson (Hydrolytics)
- 4.2 08:50am - Dr Attilio Pigneri (The Hydrogen Utility)
- 4.3 09:10am - Mr Karan Bagga and Mr Rhys Tucker (ThyssenKrupp Industrial Solutions (Australia))
- 4.4 09:30am - Mr John Mott (Ammonia Safety and Training Institute
- 09:50am - Q&A Panel Session

10.30 am – 11.00 am Morning tea break

11.00 am – 12.30 pm Panel Review Session
- 11:00am - Building an energy export industry using Green Ammonia
- 11:20am - Green Ammonia as a maritime bunker fuel
- 11:40am - Green Ammonia as a grid scale energy storage – battery to the nation

12:00pm – 12:30pm Conference Wrap Up

12.30pm Close Conference

Opening address

Honourable Lily D’Ambrosio

Minister for Energy, Environment and Climate Change,
Minister for Solar Homes

Plenary Speaker

Mr Shigeru Muraki

Representative Director at the Green Ammonia Consortium (Japan) and Executive Advisor at Tokyo Gas

"Ammonia, Key Green Energy for Decarbonization"

Biography

Shigeru Muraki has been Executive Adviser of Tokyo Gas since April 2015. He joined Tokyo Gas in 1972 after graduating Tokyo University. He was appointed Executive Vice President in 2010 and Vice Chairman in 2014. He was Program Director of Energy Carriers for SIP (Cross-ministerial Strategic Innovation Promotion Program) from May 2014 to March 2019. He has been Representative Director of the Green Ammonia Consortium since July 2019. He has assigned to Regional Vice Chair, Asia Pacific and South Asia, of World Energy Council since May 2016.

Abstract

Japanese R&D program SIP Energy Carriers developed technologies to utilize ammonia directly in energy sector. Those results prove ammonia is viable option of C-free fuel in power generation, industrial and maritime markets. We plan to start commercial use of C-free ammonia in the middle of 2020s.

Session 1.1

Mr John Bøgild Hansen – Haldor Topsøe

“High efficiency ammonia synthesis systems”

Biography

John Bøgild Hansen is Senior Principal Scientist in Chemicals Research & Development of Haldor Topsøe A/S. He graduated with a MSc in Chemical Engineering from DTU in 1975 and has been employed by Haldor Topsøe since then. Initially he worked in the catalyst division but in 1979 joined the R&D Division where he became department manager in 1985. He was responsible for fuel processing for fuel cells, ammonia, methanol, DME, gasoline and reforming catalyst as well as the related process technology development. In 2000 he became Senior Scientist and Advisor to the chairman, Dr. Haldor Topsøe mainly on energy related issues as hydrogen and synthetic fuel production, fuel cell and electrolyser system development as well as biomass utilisation. In 2015 he moved back to the R&D Division. John Bøgild Hansen holds 32 patents and has published more than 70 papers. He has been the organizer and chairman of fuel cell fora and catalysis seminars.

Abstract

Haldor Topsøe A/S has developed a new technology for generation of ammonia synthesis gas via Solid Oxide electrolysis, which eliminates an air separation unit and has 20-30 % lower power consumption than traditional electrolysis based processes. The concept will be demonstrated in a 50 kW unit along with test of ammonia as fuel for Solid Oxide Fuel Cells. The partners in the project are: Vestas, Ørsted, Energinet, Aarhus University and DTU.and it is sponsored by the Danish Energy Development Programme

Session 1.2

Professor Doug MacFarlane – Monash University

"Progress and challenges in ammonia synthesis by electrochemical processes"

Biography

Professor Doug MacFarlane is an Australian Laureate Fellow at Monash University's School of Chemistry and leader of the Energy Program in the Australian Centre for Electromaterials Science. He is the Australian Academy of Science's Craig Medalist 2018 and winner of the Victoria Prize for Science and Innovation 2018. His interests cover a broad range of materials chemistry for renewable energy generation and storage. He has published more than 650 papers and 30 patents, including papers in Science and Nature. Professor MacFarlane was elected to the Australian Academy of Science in 2007 and the Academy of Technological Sciences and Engineering in 2009. He is also the chief investigator for two ARENA awarded grants with projects titled "Ammonia Production from Renewables at Ambient Temperature and Pressure" and "Low-cost, robust, high-activity water splitting electrodes".

Abstract

Efficient production of ammonia from renewable energy represents an important technology for future means of global transportation of renewable energy from remote land and marine areas where it can be generated inexpensively at massive scale. The direct electrochemical nitrogen reduction reaction (eNRR), coupled with the oxygen evolution reaction (OER), is an attractive approach to the generation of ammonia from renewables and this talk will overview the technology options in respect of this process.

The eNRR as carried out in traditional solvents is of relatively low efficiency under ambient conditions compared to other energy storage mechanisms and this is currently limiting the technology.1 One of the reasons for this low efficiency is the very poor solubility of N2 in many electrochemical solvents. Fortunately, some non-aqueous electrolyte systems offer considerably higher nitrogen solubility, up to 20 times or more than in water, and this has allowed us to demonstrate breakthrough levels of selectivity in this reaction.2-5 We will discuss recent progress in this area and the likely trajectory for future development.

References

1. B. H. R. Suryanto, H.-L. Du, D. Wang, J. Chen, A. N. Simonov and D. R. MacFarlane, *Nature Catalysis*, 2019, **2**, 290–296.
2. F. Zhou, L. M. Azofra, M. Ali, M. Kar, A. N. Simonov, C. McDonnell-Worth, C. Sun, X. Zhang and D. R. MacFarlane, *Energy Environ. Sci.*, 2017, **10**, 2516-2520.
3. C. S. M. Kang, X. Zhang and D. R. MacFarlane, *J. Phys. Chem. C*, 2018, **122**, 24550-24558.
4. B. H. R. Suryanto, C. S. M. Kang, D. Wang, C. Xiao, F. Zhou, L. M. Azofra, L. Cavallo, X. Zhang and D. R. Macfarlane, *ACS Energy Letters*, 2018, **3**, 1219-1224.
5. B. H. R. Suryanto, C. S. M. Kang, X. Zhang and D. R. MacFarlane, *J Phys Chem C*, 2019, In press.

Session 1.3

Mr Martin Hablutzel - Siemens

"Manufacturing ammonia from renewable energy – demonstrator and scale-up potential"

Biography

Martin Hablutzel is the head of strategy for Siemens Ltd working across all Siemens divisions along the electrification value chain that extends from generation, transmission, distribution and smart grid to the efficient application of electrical energy through automation and digitisation.

Martin began his career at the (then) Hydro Electric Commission in Tasmania, joining Siemens in 1997 as a protection and control engineer. Subsequent roles in project engineering, project management, asset management, sales, marketing and executive management have given Martin broad exposure to the deployment of electrification, automation and digitalisation in diverse industries including utilities, resources, infrastructure, transportation and manufacturing.

Martin holds a degree in electrical engineering from the University of Tasmania and an MBA from Deakin University.

The presentation will:

- Provide an update of the working demonstrator at Rutherford Appleton Laboratories near Oxford where ammonia is produced from renewable energy and used to fuel a generator.
- Discuss the status of hydrogen production technology and scale-up plans.

Session 2.1

Who is the Ammonia Energy Association?

The Ammonia Energy Association, previously known as the NH3 Fuel Association, is a group of businesses, organisations and individuals who promote ammonia playing a central role as a carbon free fuel in the future global energy sector.

Established in August 2017, the Australian chapter of the association provides a space where the ammonia community can deliberate current topics and challenges relevant to the adaptation, development and promotion of ammonia as a liquid energy carrier. Items on meeting agendas range across all corners of the sector including: grass roots research to large scale production, supply, logistics, infrastructure and safety as well as fertiliser production.

Please email John Mott at nh3fa.oz@gmail.com to join the mailing list.

Session 2.2

Dr David Harris – CSIRO

"Ammonia as a hydrogen energy carrier”

Biography

David leads CSIRO's Low Emissions Technologies Program which is focussed on providing technology pathways for low emissions energy systems to increase efficiencies and reduce costs of greenhouse gas reduction options while ensuring secure and sustainable energy supply. The LET program comprises approximately 100 staff working across the major energy technology sectors including Solar Thermal and PV technologies; advanced fossil fuel, thermal and electrochemical energy processes; hydrogen energy systems; and emissions monitoring, modelling and management.

David’s team has well-established collaborative links with the major energy research and technology institutions within Australia and extensive research links with international research organisations and technology development companies in Japan, China, Korea, Europe, USA, India and South Africa.

Session 2.3

Mr Chris Rijksen –
Yara Pilbara Fertilisers

"Green hydrogen feed for Haber Bosch ammonia synthesis"

Biography

Mr. Chris Rijksen has been the General Manager / Plant Manager of Yara International's Yara Pilbara Ammonia and Technical Ammonium Nitrate operations in Karratha since January 2017.

Previously Chris was Yara's Technical Process Owner for Maintenance and Inspection for six years in Belgium, responsible for all technical maintenance disciplines and inspection strategy development and support for 30 Yara production sites world-wide.

As Maintenance Manager and member of the site management team of Yara's largest production site in Sluiskil in the Netherlands, Chris oversaw a workforce of 150 maintenance employees , with responsibility for daily maintenance, shutdowns, projects and modification projects.

Chris was also the Energy and Development Manager at Sluiskil, heading up the implementation of emission monitoring and trading and responsible for electricity and gas procurement strategies. Prior to this, he was the Deputy Production Manager of Sluiskil's nitric acid and utilities production departments across two nitric acid plants, three power plants and four water production plants and managed the construction of a new power plant and high voltage distribution grid.

Chris is a member of the WA Hydrogen Council who has recently provided the WA Renewable Hydrogen Strategy to WA State Government.

Chris has a Masters in Electrical and Control Technics from the Eindhoven

University of Technology (Netherlands) and a Bachelor in Electrical Energy Systems and Control Technics from Hogeschool Zeeland (Netherlands).

Abstract

Yara is heading towards carbon free operations. The Renewable Ammonia Project that Yara is working on together with Engie for Yara Pilbara is one of the first major steps moving in this direction

There are still many challenges ahead but Yara feels very well placed to be a key player and first mover in the renewable Ammonia space, supporting our drive to be the Crop Nutrition Company for the Future.

Session 2.4

Dr Charlotte Rouse –
Australian Renewable Energy Agency

“Ammonia’s role in a renewable energy future”

Biography

Charlotte leads the hydrogen strategy development at the Australian Renewable Energy Agency (ARENA), and also works on the design and implementation of programs to support R&D and technology transfer. She has a Ph.D. in chemistry from the Australian National University.

Abstract

The creation of renewable energy export value chains is an investment priority for ARENA. One of the most promising ways of achieving this is through the production, storage and transport of renewable hydrogen. Ammonia is a potential pathway in this supply chain, however, the industry also has a key role to play in the domestic market. Domestic projects will be essential for Australia to reach the scale required for hydrogen export, and de-risk and address challenges along the way. This talk will explore the role of ammonia in ARENA's future hydrogen strategy, and discuss projects that are seeking to address barriers in the sector.

Session 3.1

Mr Lars Bryndum –
MAN Energy Solutions SE

“Ammonia as fuel for marine two-stroke diesel engines”

Session 3.2

Professor Dongke Zhang – University of Western Australia

"Ammonia as clean and zero-carbon transport fuel"

Biography

Dongke Zhang is a professor at the University of Western Australia where he is also the director of the Centre of Energy. He has received funding for his research from a wide variety of sources and has research papers published in areas studying mechanisms of catalysed reactions, NOx formation and destruction in combustion systems, zero emission energy technologies and energy options for the future.

Session 3.3

Mr Koh Eng Kiong–
Nanyang Technological University

“Alternative low carbon energy for maritime application”

Biography

Eng Kiong is Assistant Director and Senior Scientist at Maritime Energy & Sustainable Development Centre of Excellence. A passionate manager with 18 years of experience in business development and account management of research, product development and technology business. Koh’s background is in environmental engineering and has had a variety of assignments spanning industries from speciality chemical, environmental and maritime clean energy. Eng Kiong’s research interests include energy and emission management for maritime & small-scale power plants, and technology commercialization.

Abstract

Singapore is the largest trans-shipment seaports in the world that has connectivity to 600 ports in over 120 countries. The country has a thriving maritime cluster that comprises over 5,000 maritime-related establishments contributing about 7% of the nation’s gross domestic product. With the growth in world trade and expanding future port activities, the Greenhouse Gases (GHG) emission from the local ports is expected to increase in tandem to support the wide range of essential port services. This is a challenge for Singapore and the maritime industry as global climate change agreements call for the reduction in GHG emission. This presentation will share some studies done by the centre on the sources of alternative fuels and its maritime applications, including Singapore’s context, shedding lights on the potential demand for green ammonia.

Session 4.1

Ms Claire Johnson – Hydrolytics

“Australia's hydrogen transition: Mobility projects as a catalyst to large-scale export”

Biography

Claire Johnson is the Co-Founder & CEO of data intelligence startup, Hydrolytics. Hydrolytics provides data driven insights into hydrogen and other sustainable technologies to enable the growth of the clean energy sector.

Prior to launching Hydrolytics in 2019, Claire was the CEO of Hydrogen Mobility Australia, the industry association representing Australia’s emerging hydrogen sector. In this role, Claire advocated for the introduction of hydrogen and fuel cell technologies to Australia with governments, industry and the community.

Claire has a background in policy development and government relations across the private and public sectors, including as manager of government affairs at Toyota Australia. In this role she led the company’s government engagement program for a range of transport policy areas, including the introduction of hydrogen fuel cell electric vehicles to Australia.

Claire has also worked for Australian federal and state governments in policy development, including industry, environmental and trade policy. Claire holds a Bachelor of Economics and a Master of Marketing from the University of Tasmania.

Abstract

With Australia's eye firmly fixed on becoming a major hydrogen export player, hydrogen mobility opportunities sometimes gets overlooked. Claire will discuss the important role that fuel cell vehicles and their infrastructure can play in enabling a hydrogen export sector in Australia, including the potential uptake rates out to 2030 and what governments need to do to make this happen.

Session 4.2

Dr Attilio Pigneri –
The Hydrogen Utility (H2U)

"Green ammonia synthesis – Australian pilot project"

Biography

Over fifteen years of experience at the interface between R&D Planning and Commercialization for sustainable energy technologies and alternative energy infrastructures.

Extensive academic and professional experience in the areas of integrated energy and environmental research and policy advising. Strong research and consulting focus on systems analysis for management and planning of alternative energy, sustainable transport infrastructures and climate change mitigation initiatives.

Demonstrated project management, team leadership, stakeholders' consultation and engagement capabilities.

Academic teaching and professional training experience in international environments (Italy, EU, China, USA, Australia and New Zealand).

Specialties:
Integrated Energy Resource Planning.
Greenhouse Gas Mitigation Assessment.
Integrated Technology Assessment for Energy Systems, Energy Efficiency and Renewables. Systems Analysis and GIS-based Planning.

Session 4.3

Mr Rhys Tucker and Mr Karan Bagga – ThyssenKrupp Industrial Solutions (Australia)

"From Micro to Mega, how the green ammonia concept adapts"

Biography

Karan Bagga is the Chief Engineer for thyssenkrupp, Australia. He is responsible for furthering and implementation of thyssenkrupp technologies in the field of conventional and green hydrogen and ammonia in Australia. A keen technologist, he has expertise in design, optimisation and operation of hydrogen and ammonia value chain facilities. He is also an active member of Australian Standard technical committee for hydrogen technologies.

Rhys Tucker is the National Manager - Business Development for thyssenkrupp. He is responsible for promoting thyssenkrupp chemical and plant technologies in Australia. Rhys is a chemical engineering Fellow who is experienced in the design and optimisation of hydrogen and ammonia plants.

Abstract

Green ammonia concepts from thyssenkrupp are available from 50 to over 5000 tonnes per day. Variability of electrolytic hydrogen feed presents one of the biggest and unique challenge in achieving an optimal and stable functioning of the Haber-Bosch synthesis loop. The solutions to these challenges require a customised approach, dependent on scale and power generation mix of the of the facility. At thyssenkrupp, Australia, we offer local expertise in optimising the concepts for your small and large scale green ammonia applications, underpinned by our know how as a world leading electrolysis and ammonia technology supplier.

Session 4.4

Mr John Mott –
Ammonia Safety and Training Institute (ASTI)

"Issues affecting safety risks with ammonia storage, transport and distribution"

Biography

John graduated in Mechanical Engineering from the Bendigo Institute of Technology in 1973.

His career in the industrial refrigeration industry using ammonia, has spanned 45 years, the last 20 years of which John was CEO of Gordon Brothers, Australia's pre-eminent ammonia refrigeration manufacturer and contractor.

John has been active in a number of industry bodies during his career and has continued involvement with the AEA and ASTI into his retirement.

John is:

- Fellow of the Institution of Engineers Australia (FIEAust)
- Fellow of the Australian Institute of Refrigeration, Air conditioning and Heating (FAIRAH)
- Affiliate member of the Board of Directors of the Ammonia Safety and Training Institute (ASTI)
- Chair of the Australian chapter of the Ammonia Energy Association (AEA)

Notes