



# 40th Anniversary Flow Battery Innovation Symposium

*Tyree Energy Technologies Building  
UNSW Sydney*

**15 & 16  
OCTOBER  
2024**

Supported by:



**UNSW**  
SYDNEY

**Engineering**

School of Chemical Engineering  
School of Mechanical Engineering  
School of Electrical Engineering & Telecommunications

# Symposium Organising Committee



**Emeritus Professor  
Maria Skyllas-Kazacos**  
UNSW Sydney



**Professor Jie Bao**  
Director  
ARC Research Hub for Integrated Energy  
Storage Solutions



**Associate Professor  
Chris Menictas**  
UNSW Sydney



**Monica Brockmyre**  
Business Manager  
ARC Research Hub for Integrated Energy  
Storage Solutions

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*First researchers (left to right, top to bottom): Bob Brand, Elaine Sum, Miron Rychcik, Franz Grossmith, Michael Kazacos, Maria Skyllas-Kazacos, Rod McDermott, Martin Green, Bob Robbins, Tony Fane, first vanadium flow cell*

# Symposium Agenda

Tuesday | October 15 | 2024

Registration, Coffee & Tea	
9:00	<b>Opening</b> <i>Maria Skyllas-Kazacos</i>   <b>Welcome</b> UNSW Vice Chancellor <i>Attila Brungs</i>
9:10	<b>Historical overview 40 years @ UNSW</b> <i>Maria Skyllas-Kazacos (UNSW)</i>
9:45	<b>Early commercialisation and field trials</b> <i>Kanji Sato (ex-Sumitomo/Mitsubishi)</i>
10:05	<b>Current flow battery R&amp;D @ UNSW</b> <i>Chris Menictas &amp; Jie Bao (UNSW)</i>
Morning Tea	
11:00	<b>Advancements &amp; Deployment of Sumitomo's Flow Battery Technology</b> <i>Toshikazo Shibata (Sumitomo)</i>
11:20	<b>Australian Project Updates</b> <i>Michael Rutt (Invinity Energy Systems)</i>
11:40	<b>VFB Progress in China</b> <i>Ao Tang (Institute of Metal Research, Chinese Academy of Sciences)</i>
12:00	<b>Resource, electrolyte &amp; battery projects</b> <i>Graham Arvidson (Australian Vanadium Limited)</i>
Lunch	
13:20	<b>VFB implementation in the resource sector</b> <i>Tomas Mach (Rio Tinto)</i>
13:40	<b>15 years of flow battery development at Fraunhofer ICT</b> <i>Jens Noack (Fraunhofer ICT)</i>
14:00	<b>New directions in long duration energy storage R&amp;D</b> <i>Asem Mousa (CSIRO)</i>
14:15	<b>Panel Discussion: Flow battery market development in Australia</b> <i>Moderator: Grant King (Transgrid, ex-Climate Change Authority &amp; Origin Energy)</i> <i>Panellists: Stephanie Banning (VSUN), Noel Ryan (Energy Policy WA), Michael Rutt (Invinity Energy Systems), Chris Peet (Stanwell Corporation), Peter Morrow (AusFlow Energy)</i>
Afternoon Tea	
15:30	<b>European developments in flow batteries</b> <i>Anthony Price (IFBF)</i>
15:45	<b>Q&amp;A with Maria Skyllas-Kazacos</b> <i>Interview with Elysse Morgan</i>
16:00	<b>Visit to VFB Facility, Poster Session and Drinks</b>
<b>6:00 PM - Symposium Dinner at The Lounge at UNSW</b>	

# Wednesday | October 16 | 2024

Registration, Coffee & Tea	
9:00	<b>Opening</b> <i>Chris Menictas</i>   <b>Welcome</b> UNSW Dean of Engineering <i>Julien Epps</i>
9:15	<b>Commercial iron flow battery developments in Australia</b> <i>Peter Briede (ESI-AP)</i>
9:40	<b>Microemulsion flow batteries</b> <i>Thomas Nann (Allegro)</i>
10:00	<b>Energy storage: Indispensable to the energy transition</b> <i>Edwin Ong (Transgrid)</i>
Morning Tea	
10:45	<b>Panel Discussion: Policy &amp; funding support to take a nascent market to a thriving market</b> <i>Moderator: Quentin Hill (ABMC)</i> <i>Panellists: John Grimes (Smart Energy Council), Tim Buckley (Climate Energy Finance), Niall Brady (Clean Energy Finance Corporation), Stephanie Bashir (Nexa Advisory)</i>
11:30	<b>The supply chain opportunity</b> <i>Jeremy Peters (Vecco Group)</i>
11:45	<b>Advancing renewable energy solutions in Australia</b> <i>Brendon Grylls (Richmond Vanadium Technology)</i>
Lunch	
13:00	<b>Vanadium Technology Pathways</b> <i>Grant Wilson (Tivan)</i>
13:15	<b>Julia Creek project updates</b> <i>Gavin Loyden (QEM)</i>
13:30	<b>Flow battery projects at the QUT Advanced Battery Facility</b> <i>Joshua Watts (QUT, National Battery Testing Facility)</i>
13:45	<b>QLD Battery Industry Development Program</b> <i>Lynette Molyneaux (Advanced Materials &amp; Battery Council)</i>
Afternoon Tea	
14:30	<b>Panel discussion: Building Flow Battery Manufacturing in Australia</b> <i>Moderator: Joshua Watts (QUT, National Battery Testing Facility)</i> <i>Panellists: Young Yu (AVESS), Mark Reynolds (Australian Flow Batteries), Dr. Shin Han (H2, S. Korea), Jeremy Peters (Vecco Group), Peter Briede (ESI-AP), Arata Doi (Sumitomo Electric)</i>
15:30	<b>Closing</b>
ANFLOW Meeting	

# Our Speakers



**GRAHAM ARVIDSON**  
CEO

**Australian Vanadium Limited**



**STEVE BANNING**  
Principal Advisor

**VSUN Energy**



**STEPHANIE BASHIR**  
Founder & CEO

**Nexa Advisory**



**NIALL BRADY**  
Head of Solar and Storage  
**Clean Energy Finance Corporation**



**PETER BRIEDE**  
Executive General Manager  
**ESI Asia Pacific**



**TIM BUCKLEY**  
Director  
**Climate Energy Finance**



ARATA DOI  
Manager, Business  
Planning Department  
**Sumitomo Electric**



JOHN GRIMES  
CEO  
**Smart Energy Council**



BRENDON GRYLLES  
Board Chair  
**Richmond Vanadium  
Technology**



SHIN HAN  
Founder & CEO  
**H2 Incorporated**



QUENTIN HILL  
CEO  
**Advanced Materials &  
Battery Council**



GRANT KING  
Professor of Practice,  
Board Chair  
**UNSW Energy Institute**

# Our Speakers



GAVIN LOYDEN  
Managing Director

**QEM Limited**



TOMAS MACH  
Science Manager –  
Innovation Science and  
Technology Group  
**Rio Tinto**



LYNETTE MOLYNEAUX  
Director

**Advanced Materials &  
Battery council**



PETER MORROW  
Founding Director

**AusFlow.Energy**



ASEM MOUSA  
Director – Revolutionary  
Energy Storage Systems  
FSP  
**CSIRO**



THOMAS NANN  
CEO

**Allegro Energy**





**JENS NOACK**  
Project Leader –  
Redox Flow Batteries  
& Renewable Energy  
Storage  
**Fraunhofer ICT**



**EDWIN ONG**  
Senior Engineer,  
Innovation and Energy  
Transition Team  
**Transgrid**



**CHRIS PEET**  
General Manager –  
Future Energy Origination  
**Stanwell Corporation**



**JEREMY PETERS**  
General Manager –  
Energy  
**Vecco Group**



**ANTHONY PRICE**  
Director  
**Swanbarton Limited**



**MARK REYNOLDS**  
Director  
**Australian Flow Batteries**

# Our Speakers



MICHAEL RUTT  
Regional Director  
Australia Pacific  
**Invinity Energy Systems**



NOEL RYAN  
Assistant Coordinator  
Market Development  
**Energy Policy WA**



KANJI SATO  
Director  
**SEE-I Institute of  
Technology**



TOSHIKAZU SHIBATA  
Deputy General Manager,  
Energy Systems Division  
**Sumitomo Electric  
Industries Limited**



AO TANG  
Professor  
**Chinese Academy of  
Sciences**



JOSHUA WATTS  
Project Lead  
**National Battery Testing  
Centre**



**GRANT WILSON**  
Executive Chairman

**Tivan**



**YOUNG YU**  
Managing Director

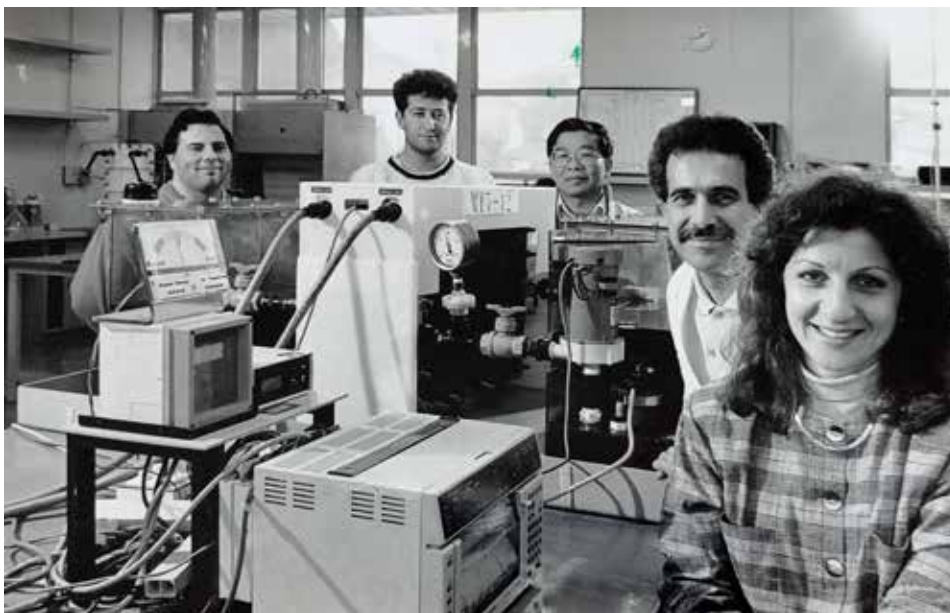
**AVESS Energy**



*First vanadium flow cell*

# Poster Session Overview

- **Innovative Zn<sup>2+</sup> Solvation Structure in Aqueous Electrolytes for Advanced Zinc-Bromine Flow Batteries**  
*Norah Alghamdi, University of Queensland*
- **Economic Model Predictive Control of Vanadium Redox Flow Batteries for Power Arbitrage**  
*Shail Godiwala, UNSW Sydney*
- **A 3D Hydraulic Model for Flow Battery Stack Design Optimisation**  
*Xinjie (Jack) Guan, UNSW Sydney*
- **A coupled hydraulic and electrochemical stack and system model for aqueous organic flow battery: the MV/TEMPTMA system**  
*Xinjie (Jack) Guan, UNSW Sydney*
- **Functional materials for high performance iron flow battery**  
*Cailing He, University of Queensland*
- **Analytical methods for vanadium electrolytes and standardization work**  
*Jens Noack, Fraunhofer ICT*
- **Capacity Expansion of a VRFB Cell and the resulting challenges for a BMS**  
*Jens Noack, Fraunhofer ICT*



*Early research team (1990s) left to right: Jim Wilson, Alex Stefos, Rui Hong, Michael Kazacos, Maria Skyllas-Kazacos*



Vanadium solution colours: different oxidation states

- **Development of test environments and methods for the characterisation of redox flow stacks**  
*Jens Noack, Fraunhofer ICT*
- **Investigating the Electrochemical Behavior of Iron/Hydrogen Recombination Cell in Iron/Iron Redox Flow Batteries**  
*Jens Noack, Fraunhofer ICT*
- **Advancements in Thermal Modelling, Hybrid Cooling Strategies, and Electrical Safety for Containerised Vanadium Flow Battery Systems**  
*Bing Shu, UNSW Sydney*
- **Enhancing Electrolyte Stability and Performance in Vanadium Redox Flow Batteries through Inorganic Additives Investigation**  
*Yuheng (Carolyn) Tian, UNSW Sydney*
- **Stack layer order in Vanadium Oxygen Fuel Cells**  
*Robert Turney, UNSW Sydney*
- **Ore-chemstrating Net-Zero: a techno-economic comparison of lithium batteries and vanadium flow batteries in a Western Australian mine site**  
*Pujith (PJ) Vijayaratanan, UNSW Sydney*
- **Full State Concentration Estimation for Vanadium Flow Battery**  
*Lai Wei, UNSW Sydney*
- **Optimizing Vanadium Redox Flow Battery Performance with Embroidered Porous Electrodes and Corrugated Bipolar Plates**  
*Jiangzhou Xie, UNSW Sydney*

# Attendee Organisations

## Government



## Policy & Advocacy



# Mining & Processing



# Attendee Organisations

## Research



MONASH University



THE UNIVERSITY OF QUEENSLAND AUSTRALIA





# Flow Battery OEMs & Suppliers

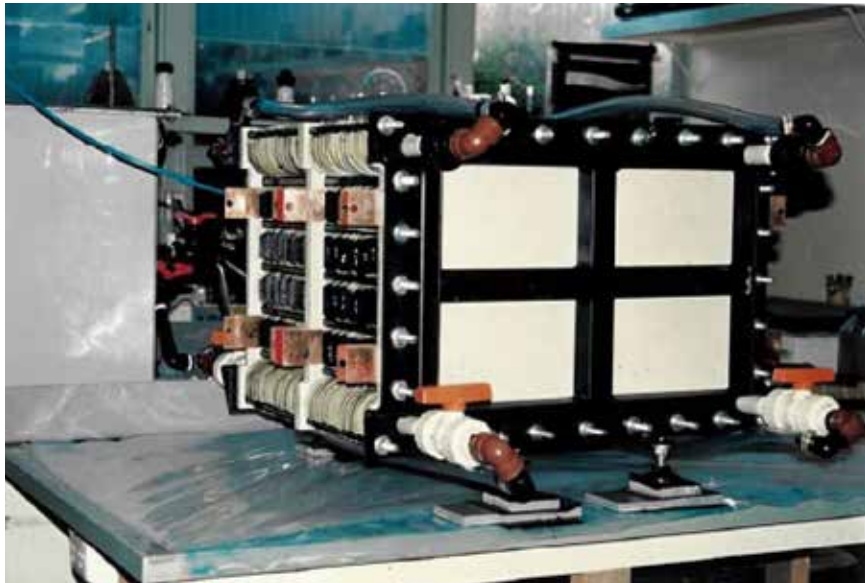


# Attendee Organisations





*First 1kW VFB*



*First 5kW VFB*

# Contributors

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Researchers, students and supporters who have contributed to the development of VFB technology at UNSW

Jeffrey Adam 2008	Nicholas Furner 2018	Rebecca Kenyon 1993
Md. Parvez Akter 2017	Mike Fynch 1998	Meng Kiat 2019
Vincent Algar	Anthony Gerber 1998	Bing Sen Koh 2012
Leonhard Alvin 2010	Allan Giddy 2012	Anders Kronander
Alfio Arcidiacono 2009	Shail Godiwala 2023	Robert Largent 1993
Amadeo Banzato 1999-2002	Leesean Goh 1998	Anna Lee 2013
Jie Bao 2010	Marc-Antoni Goulet	En Leng Lee 2013
Ashley Becker 2012	Martin Green	Joseph Lentini
Craig Benson 1992	Franz Grossmith 1986	Alvin Leonardi 2010
Michael Borman 1986	Xinjie Guan 2023	Tween Teng Leong 2005
Mike Brungs	Vahid Haddadi-Asl 1995	Yifeng Li 2014
Rob Burford 1991	Christoph Hagg 1999	Jui-Ko Li 2012
Liuyue Cao 2022	David Hogg 1986-96	Jun Li 2013
Amanda Channing 2010	Sue Holme 1998	Tuti Lim 1991
Andrew Chau 1988-90	Dun Rui Hong 1990	Yuni Limantari 2004, 2010
Norfamila Che Mat 2008	Wendy Hong Anh 1990	Lionel Ling 2014
Min Cheng 1990	Russell Howe 2001	Lisboa Lisinio 2002
Winnie Cheuk Cheung 2015	Adam Jeffrey 2008	Gamini Liyadipitiya
S.C. John Chieng 1992	Jaqui Joy 1989	Paul Llewellyn 1986-88
Nak Heon Choi 2011	Jesse-Yizhou Ju 2005	Elisha Ma 2017
Petrina Choong 1996	Djen Kasherman 1991	Barry Madden 1989
Elizabeth Cohen 2002	Nadeem Kausar 2001	Susan Marston 1999
Sara Corcuera 2012	Nicholas Kazacos 1996-98, 2003, 2005-07	Robert McAuley 1990
Jon Estornés 2012	George Kazacos 2005-10	John McCann
Tony Fane	Michael Kazacos 1988	Ryan McCloy 2020
John Fletcher	Anthony Kazacos	Luke McDermott 2009-10
		Rod McDermott 1988-91

David McKay 2000	Sarah Roe 1998, 2014	Mariana Tjokrowidjaja 1988
Sarah McKinlay 2003	Miron Rychcik 1986-88	Tam Tran 1994
Ke Meng	Mohammed Kahlid Saeed 2007	Phan Trinh 1991
Chris Menictas 1992	Agus Sani 2002	Mery Tuerah 2008
Nicholas Milne 2002, 2006	Kanji Sato	Hugh Verseema 2007, 2010
Fereidoon Mohammadi 1994	Bing Shu 2023	John Vierkant 1995
Toraj Mohammadi 1995	Yaw Lim Sim 2005	Pujith (PJ) Vijayaratnam 2022
Joe Morabito 1985	Yuan Siyu 2010	Tay Kian Wah 2000
Michael Moses 2007	Andrew Smith 1997	Mark Wainwright
Asem Mousa 1998	Alex Stefos 1992	Richard Walker 1986-96
Kristina Murphy 2023	Andrew Steil 2006	Logan Weber 2016
Katia Nasev	Theresa Sukkar 2003	Peter Wegner 1989
Tharathon Navaphol 2005	Sulide Suld	Lai Wei 2024
Jens Noack	Elaine Sum 1984	Barry Welch
Janephum Olansathit 2011	Biantin Sun 1991	Bingyi Wen 2013
Kathryn Olney 1995	Longgang Sun	Melinda Widjaja 2010
C. Padeste 1993	Ao Tang 2011	Jim Wilson 1994
Christina Peng 1990, 1999	Chung Hang Tang 2011	Jiangzhou Xie 2023
Paul Pennesi 1993	Andrew Tham 1996-97	Yitao Yan 2015
Grace Poon 2008	Yuheng (Carolyn) Tian 2024	Z.H. Dennis Yan 1991
Helen Vafiadis Prifti 2006	P. Timbrell 1994	Zuyu Ye 2010
Ryana Rachmat 2008	Simon Ting 1988	Zuyu Yi 2006
Faizur Rahman 1998	Victoria Timchenko 2018	Xinan Zhang 2016
Nicola Reid 2004	Kitiono Tio 1987	Shi Zhong 1991, 1996
Mandar Risbud		
Bob Robins 1982-88		



**With special thanks to**

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Samantha McGahan  
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Joanne Bergamin  
Tim Lamacraft  
Mel Boudib  
Rob Largent  
Hannah Liao  
UNSW Digital Grid Futures Institute

*Chris Menictas circa 1996*



ARC Research Hub for  
**Integrated Energy Storage Solutions**