



## Our vision and mission

The basic configuration of electrical power systems for industrial, commercial, and residential applications has altered little for decades. However, disruptive new technologies, such as hybridisation and power conversion, are bringing big changes similar to what is already happening for electric vehicles.

Of course, micro-grids and building-level storage have different energy needs than electric vehicles. An electrical system's requirements depend on its application, so end use should strongly influence design at every level – from component design to material selection. However, this is often not the case and hybrid systems largely just combine existing components.

Our vision is to foster a paradigm shift where end use guides the design of efficient, more affordable, more durable energy sources.

## Our approach

The Net Zero Initiative at the University of Sydney fosters a high level of collaboration and knowledge-sharing across energy research groups. Their goal is to address key research questions in the development and roll-out of optimised hybrid technologies and to develop component and material performance guidelines that consider end use requirements.

## Our research

A key Enabling Research Theme of the Net Zero Initiative (NZI) is 'Emissions Avoidance through Zero Emissions Energy'. Under the research pillar 'Energy Hybridisation', we are developing closer links between component-level research and application-oriented work. The areas we are addressing include:

- Material development and component design for improved performance;
- System modeling, integration and control;
- Component health management and degradation.

We are particularly interested in optimising energy source durability through the tailored design of materials and improved load-sharing and use of components. To this end, our researchers seek to answer the following questions:

- How can we translate application-level requirements and degradation into component and material performance guidelines?
- Can improved load-sharing lead to extended life for each individual energy source?
- How different are component requirements for applications like electric vehicles, micro-grid, building level storage, and electric vertical take-off and landing aircraft?

### Meet our research experts

Our interdisciplinary research team leverages outstanding capabilities and infrastructure. Experts working under this pillar include:

#### School of Aerospace, Mechanical and Mechatronic Engineering

**A/Professor Dries Verstraete (lead)** Specialises in integration challenges and durability of hybrid systems for aerospace applications.

#### School of Electrical and Information Engineering

**Professor Jian Guo Zhu** Specialises in control and energy management of fuel cells and fuel-cell-based hybrids systems.

#### School of Chemical and Biomolecular Engineering

**Professor Yuan Chen** Specialises in carbon materials and their sustainable energy and environmental applications, including supercapacitors, batteries, electrocatalysts, membranes and antibacterial coatings.

#### School of Chemistry

**Professor Kondo-Francois Aguey-Zinsou** Specialises in hydrogen technologies and custom designs of fuel cells.

### How your business will benefit

By partnering with us, your business will be able to:

- Collaborate with leading academic and industry experts from the University of Sydney to address the challenges faced by your business;
- Help shape the next generation of postgraduate students with skills relevant for your business needs;
- Host one of our talented PhD students, who will be placed in your business for up to one year; and
- Benefit (pending eligibility) for the Australian Government's R&D Tax Incentive Scheme.

### Past projects

We have a strong track record of partnering with industry to investigate and develop new hybrid systems. A key example of our impact in this space includes our work on developing fuel-cell-based hybrid systems for electric vertical take-off and landing (eVTOL) aircraft. This is an Industry led partnership with AMSL Aero. Additional partners include Careflight and Advanced Power Drives. This project is supported by Cooperative Research Centre Projects (CRC-Ps).

Our team members have also developed several world-firsts including the first flight of a triple-hybrid fuel-cell-based system for aircraft, hydrogen bikes, and hydrogen BBQs.

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### Contact us

For further information or to discuss in greater detail, please contact:

#### Net Zero Initiative

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