

# **Heat Pumps and Solar Energy: Real-World Applications for Reducing Fossil Fuel Consumption**

**Lu Aye**

Professor of Energy Engineering  
Leader of the Renewable Energy and Energy Efficiency Group  
Department of Infrastructure Engineering  
Faculty of Engineering and Information Technology  
The University of Melbourne  
Vic 3010, Australia  
[lua@unimelb.edu.au](mailto:lua@unimelb.edu.au)

## **Abstract**

Moving to low-carbon operations requires solutions that work in practice, can scale with demand, and make financial sense. This keynote looks at how heat pumps, solar panels, and renewable energy systems can be used effectively in factories, offices, and buildings. Using examples from research projects and real installations, the presentation demonstrates proven ways to cut energy use, reduce emissions, and build reliable systems. The presentation covers what makes projects succeed—from designing and fine-tuning systems to long-term performance, cost-benefit analysis, and integration with existing equipment. It also explores new developments in hybrid systems, advanced heating and cooling, and smart energy management. By connecting engineering knowledge with practical implementation, this keynote provides industry leaders, engineers, and policymakers clear guidance to accelerate the shift to low-carbon energy and improve the sustainability of energy-intensive manufacturing operations.

## **Keywords**

Heat pump, Solar energy, Renewable energy, Energy efficiency, Low-carbon

## **Biography**

**Lu Aye** is the leader of the Renewable Energy and Energy Efficiency Group in the Department of Infrastructure Engineering at the University of Melbourne, Australia. With more than 40 years of engineering experience, he has built an international reputation as an expert in low-carbon technologies for built environment applications, spanning university teaching, research, development, demonstration, and commercialisation of renewable energy and energy efficiency technologies. Professor Aye's research focuses on heating, ventilation, air-conditioning and refrigeration (HVAC&R) systems, waste-to-resources applications, and complex systems modelling. He applies phenomenological modelling and simulation approaches to optimise energy systems, while also using computational and participatory methods for modelling socio-ecological systems under deep uncertainty. His system models serve practical purposes, identifying the effects of policy interventions. They also support robust decision-making processes. Professor Aye has been recognised as a leading expert in modelling, simulation, optimisation, and forecasting of complex systems behaviours. Through his work, Professor Aye bridges rigorous engineering research with real-world implementation, supporting industry, government, and community partners in accelerating the transition to sustainable operations. His contributions continue to inform policy development and guide the adoption of energy-efficient technologies across Australia and beyond.