UTS Institute for Sustainable Futures

Industry PhD scholarship at Institute for Sustainable Futures

Data-driven Strategies for Flexible Energy Demand in Business

Summary

An exciting opportunity for a PhD scholarship is available at the Institute for Sustainable Futures (ISF), University of Technology Sydney (UTS), developing an adaptable, easy, trustworthy, and financially feasible solution for managing flexible demand using dynamic pricing schemes within Australia's energy market. The proposed solution aims to be effective based on various segments and pricing and non-pricing signals of several electricity markets (including wholesale, network, FCAS etc.). Furthermore, the solution will simplify the process for consumers to shift their energy consumption in response to energy market prices while reducing their energy bills. The proposed model will offer valuable information and recommendations to policymakers in order to address minimum demand at minimal cost.

The research questions that this research aims to address include:

- What is the value of flexible demand in energy markets?
- What technology and data are required to enable and scale flexible demand?
- How do dynamic tariffs and incentives enable and shape flexible demand?

The successful candidate will be based at the University of Technology Sydney and work with researchers from both the Institute for Sustainable Futures (ISF) and the Data Science Institute (DSI). This project represents an excellent opportunity to conduct research that will facilitate the transition to renewable energy.

The PhD project is linked to a funded research project that is exploring how incentivising business customers to use more electricity at times of high solar generation through activating *flexible demand* (FD) is potentially a much cheaper solution than alternatives such as battery storage or network export limits on rooftop solar.

The commercial and industrial (C&I) sector offers significant opportunities for flexible demand, particularly through shifting the timing of loads such as heating, cooling, ventilation, air conditioning and refrigeration (HVAC-R), and water pumping.

This position is available to domestic and international students. The successful candidate will receive a scholarship that covers the tuition fees and a living stipend of $38,000 per annum (tax exempt) for a period of up to 3.5 years full-time study, plus some funds to support field work up to $3,000 per annum. The successful applicant can begin mid-2025. The PhD will be jointly supervised by Dr Ibrahim Ibrahim and Professor Stuart White both from ISF, and Dr Hongda Tian from DSI.

In the first instance, please submit your CV, a cover letter and a sample of your writing (as per guidelines below) by COB 13th June 2025. Shortlisted applicants will invite to final interviews on the 23rd June 2025. Shortlisted applicants will be advised of the interview outcome by the 16th June 2025. To submit your application, please email your application to ibrahim.ibrahim@uts.edu.au.

If you require further information on the position contact Dr Ibrahim Ibrahim by email on ibrahim.ibrahim@uts.edu.au.

Closing Date: 13th June 2025

Open to: Australian residents and outstanding international candidates.

Who are we looking for?

We are seeking a PhD candidate with a strong interest in undertaking high-impact research to support the transition to 100 per cent renewable energy. The successful candidate is expected to possess:

- satisfactory theoretical and applied research capabilities in mathematical modelling, ideally including experience in one or more of energy systems, AI, optimisation, machine learning and industry-focussed research;
- excellent written and oral communication skills, including the ability to participate in seminars, workshops, and other academic events, share insights and knowledge gained through research, and present research outcomes at national and international conferences;
- an ability to work collaboratively with other researchers; and
- an understanding and willingness to incorporate into academic life the principles of Equal Employment Opportunity, Affirmative Action and Environmental Health & Safety.

Research activities

Proposed research activities may include:

- searching available literature on energy efficiency and demand flexibility, particularly as they apply to the C&I sector;
- consulting with and interview relevant stakeholders, such as HVAC-R contractors or other technical personnel, to identify and estimate the size of FD opportunities, identify barriers and constraints, and determine which parts of the C&I sector are best suited to FD pilots;
- through the industry partner, assisting in identifying and recruiting at least two suitable businesses in different sectors, such as primary production (farming), and food processing and distribution;
- consulting with and interviewing businesses to better understand their operations, and identifying specific FD opportunities and constraints;
- conducting site visits with businesses;
- developing measurement and verification protocols;
- collecting, cleaning and managing energy and other data;
- learning to use an existing AI-based engine;

- developing protocols to test FD opportunities and develop risk management procedures such as sandboxing;
- modelling and analysing load flexing opportunities to estimate costs and benefits;
- implementing test protocols and ongoing data collection;
- conducting detailed analysis, including comparison between data and modelled expectations, resulting in recommendation for changes to load management systems; and
- implementing improvements and adjustments, followed by further data collection and analysis to consolidate findings.

About ISF and the Graduate Research Program

The Institute for Sustainable Futures is a leading transdisciplinary research centre with a mission of creating change towards sustainable futures. Established more than 26 years ago, ISF works with government, industry and community organisations to create a world that is socially, ecologically and economically just and safe. ISF brings together expertise from a diverse range of disciplines to deliver practical solutions for our partners, and to empower our students to effect positive change in the years to come.

Our renowned graduate research program supports students working at the leading edge of complex societal problems and sustainability challenges. The program includes retreats, peer support groups, workshops and professional development seminars to help create a supportive community of scholars. We nurture and develop the brightest, most curious minds, giving them the skills to navigate complex real-world challenges. Our vibrant community of scholars brings fresh insight, inspiring new ways of seeing – and solving – wicked problems. For more details about undertaking a PhD at ISF and student eligibility, read about our graduate research program.

About the Project

There is now more than 20 GW of rooftop solar photovoltaic (PV) capacity across Australia, with 3 GW being added each year. While this rapidly increasing penetration of rooftop solar can reduce customers' energy bills and carbon emissions, it creates significant challenges for maintaining grid stability. PV output can drive minimum demand so low that some synchronous generators must turn off, leaving insufficient inertia for a stable electricity system. One approach to managing this issue is to curtail the output of solar and wind generators; however, this wastes energy, degrades customer trust, and can significantly delay uptake of renewable energy, diminishing the associated emissions and cost benefits. And although batteries allow excess solar energy to be stored and used at a later time, the capital cost of batteries is often prohibitive.

An alternative to using curtailment or batteries to solve the mismatch between supply and demand is to incentivise customers to use more energy at times of high solar PV generation through activating *flexible demand* (FD). The C&I sector offers significant opportunities for FD, particularly through shifting of heating, cooling, ventilation, air conditioning and refrigeration (HVAC-R) loads. However, these opportunities must be balanced against other operational constraints such as maintaining productivity and product quality. Finding the most

cost-effective strategy for managing electricity demand can therefore be a challenging problem.

Artificial Intelligence (AI) is being increasingly applied to manage flexible loads. With access to suitable data, AI algorithms can be trained to predict electricity prices and other variable incentives on the supply side, as well as opportunities for demand side flexibility within the operations of business customers. Hence there is an opportunity to use AI to both optimise business operations while increasing flexible demand capacity. By employing AI, both energy providers and business consumers can optimise energy use, reduce costs, and enhance the reliability and stability of power systems.

The candidate will work with researchers from the UTS Institute for Sustainable Futures, UTS Data Science Institute and a startup company with contacts in the C&I sector and an existing AI engine to identify and pilot flexible demand solutions for C&I sector businesses, using AI and machine learning. The candidate will have some flexibility to develop their own research questions and focus, while remaining within the scope of the overall research project.

Location

Sydney, with the potential for travel as part of data collection, pending research design.

Commencement date

The scholarship will commence once the student has enrolled in a PhD program through the University of Technology Sydney.

How to apply

The application process has two stages. Please send a copy of your CV (including details of educational attainment, employment history, and publication activities,) together with a cover letter and a sample of your writing (e.g., publications, thesis, reports) to ibrahim.ibrahim@uts.edu.au by 13th June 2025.

Cover letter, CV and sample of writing

The cover letter should explain your experience and activities in three areas:

1. **Professional experience:** The strength of the professional experience will be assessed relative to the candidate's opportunities, including stage of career. The term 'professional experience' should be interpreted broadly, for example it may include both paid employment and volunteer roles.
2. **Research output:** Research outputs will be assessed on their quality and impact relative to the candidate's opportunity. Research outputs include publications (e.g. research reports, contributions to industry publications, conference papers, academic journal papers, etc.), and presentations (e.g., seminars, conferences, digital media, etc). Applicants should include documentation of their research outputs in their CV.
3. **Academic merit:** Academic merit will be assessed on:

I. The extent of successfully completed studies (e.g., Bachelor's degree, Honours degree, Masters undertaken largely by coursework, Masters undertaken largely by research etc.)

II. The demonstrated and verified level of attainment in those studies.

4. **Programming and tool development skills:** Programming and tool development skills will be assessed on:

   I. Experience with Python/Pyomo, Julia/JuMP or similar, in the context of implementation of mathematical modelling, deep (or machine) learning, optimisation, and AI applications;

   II. Experience with distributed version control (git), issue tracking (github), unit testing, continuous integration, documentation compilation and hosting; and

   III. Experience in adapting, and building on, nontrivial code bases developed by other researchers.

The sample of writing should be a research output, such as a report, university assignment, section of thesis, conference paper or journal article.

Summary timetable for application process

Call for applications open	30th May 2025
Applications close (CV, cover letter, sample of writing)	13th June 2025
Notification of shortlisted applicants for interviews	16th June 2025
Interviews with shortlisted applicants	20th June 2025
Selection of candidates	23rd June 2025

The successful applicant will need to complete an ISF pre-approval application process and be invited to submit a full application to UTS for admission in addition to this scholarship application process.

Relevant web links: ISF graduate research program and UTS postgraduate applications

UTS Institute for Sustainable Futures

Critical Thinking Assessment Frame

This frame has been adapted from what was called the Centre for Critical Thinking in the USA. It provides a useful starting point for assessing Research Outputs and Outlines of Intended Research developed by prospective research students at ISF. Generally, candidates should demonstrate 'good' or 'excellent' critical thinking skills.

Excellent	Good	Sound	Shaky	Poor
Clear Well-reasoned Insightful Self-evaluation evident Raises important questions Recognises important assumptions Clarifies key concepts Identifies competing points of view Reasons from a clearly stated premise Shows sensitivity to important implications and consequences Shows that basic concepts and principles are internalised Gives an in-depth analysis of questions and problems	On the whole is clear, precise and well-reasoned, but without depth of insight Comprehension of basic concepts and principles. Demonstrates competence in self-evaluation Often raises questions and issues Recognises some questionable assumptions Sometimes identifies competing points of view. Demonstrates commitment to reason from clearly stated premises. Sound reasoning and problem-solving within a field	Mixed thinking and performance Inconsistently clear, precise and well-reasoned Doesn't display depth of insight. Inconsistent comprehension of and internalisation of basic concepts and principles Sometimes raises questions and issues Sometimes recognises key assumptions Inconsistently uses language in accordance with educated usage Sometimes identifies competing points of view Does not demonstrate a commitment to reason from a clearly stated premise. Inconsistent reasoning and problem solving within a field	Acquisition of knowledge by memorising rather than comprehension Thinking is typically unclear, imprecise and poorly reasoned Superficial or mistaken comprehension of basic concepts and principles. Does poorly in self-evaluation Superficially analyses questions and problems Only partially clarifies concepts Rarely identifies competing points of view Does not recognise his/her assumptions Insensitive to important implications and consequences Poor reasoning and problem-solving	Acquisition of knowledge by memorising rather than comprehension Regularly unclear, imprecise and poorly reasoned Basic terms and distinctions are regularly incorrectly used Mistaken comprehension of basic concepts and principles Does not raise questions and issues Does not recognise his/her assumptions Does not clarify concepts Does not use language in keeping with educated usage Confuses his/her point of view with the truth No understanding of a commitment to reason from clearly stated premises Oblivious to important implications and consequences Incompetent reasoning and problem-solving