Faculty of Engineering and Design
Summer Research Scholarships

2026/2027 Projects (Chemical and Materials Engineering / Energy Systems)

Project code	ENG022
Project title	**Decarbonising NZ Process Industry with Very High Temperature Heat Pumps**
Discipline	Chemical and Materials Engineering / Energy Systems
Supervisor(s)	Prof. Brent Young Dr. Jun Chang
Contact details	jun.chang@auckland.ac.nz
Skills Needed	• Interest in energy systems and decarbonisation • Basic thermodynamics / heat transfer knowledge • Experience with MATLAB, Python, or process modelling tools • Data analysis and critical thinking

Project description

Industrial process heat accounts for a large share of New Zealand's energy-related emissions, particularly in sectors such as food processing, pulp and paper, and chemicals. Very high temperature heat pumps (VHTHPs) are an emerging electrification technology capable of delivering heat above 150 °C, offering a potential pathway to replace fossil fuel boilers.

This project will investigate the technical and economic feasibility of VHTHP deployment in New Zealand's process industries using simulation-based analysis. The student will develop process models of representative industrial heat demands and integrate heat pump systems to evaluate performance, efficiency, and operating characteristics.

A techno-economic analysis will be carried out to assess capital cost, operating cost, and emissions reduction under varying electricity price and carbon pricing scenarios. The project will also explore sensitivity to temperature lift, working fluids, and system design.

The outcome will provide insights into the role of VHTHPs in industrial decarbonisation and identify conditions under which they are competitive in the New Zealand context.

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2026/2027 Projects (Chemical and Materials Engineering / Energy Systems)

Project code	ENG023
Project title	**Nuclear-Integrated Pathways for NZ Net-Zero Electricity**
Discipline	Chemical and Materials Engineering / Energy Systems
Supervisor(s)	Prof. Brent Young Dr. Jun Chang
Contact details	jun.chang@auckland.ac.nz
Skills Needed	• Interest in energy systems and climate policy • Basic understanding of electricity markets or power systems • Experience with modelling tools, Python, MATLAB, etc. • Data analysis and interpretation

Project description

New Zealand has set ambitious targets for a net-zero carbon economy, with a strong focus on renewable electricity generation. However, increasing electrification of transport and industry raises questions about system reliability, cost, and security of supply, particularly during dry years.

This project will compare two future electricity system pathways: a fully renewable-based system and an alternative pathway incorporating nuclear generation. Using a simplified power system model, the student will simulate generation mixes, storage requirements, and system performance under varying demand and hydrological conditions.

The analysis will evaluate impacts on total system cost, carbon emissions, reliability, and flexibility. Key factors such as intermittency of renewables, firm capacity requirements, and potential role of nuclear as a low-carbon baseload source will be assessed.

The project will provide a quantitative comparison of trade-offs between different decarbonisation strategies and offer insights into how alternative technologies could influence New Zealand's transition to a net-zero electricity system.

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2026/2027 Projects (Chemical and Materials Engineering / Energy Systems)

Project code	ENG024
Project title	**Microfluidic Sorting of Biological Samples**
Discipline	Chemical and Materials Engineering
Supervisor(s)	Ashton Partridge Meng Wai Woo
Contact details	a.partridge@auckland.ac.nz
Skills Needed	• Fusion 360 • Operation of high-speed mini mill (note this will be taught) • Basic understanding of electrochemistry • Apt to learn how to use diagnostic equipment

Project description

Microfluidics (MF) is the study of fluid flow in channels of dimensions of less than 100 microns, at which stage laminar flow dominates. In biological sensors MF is employed to pre-process a sample (e.g. blood, urine, saliva) into its various components and ideally to isolate the target species before detection occurs. As such MF has been used for a variety of processes including mixing, sorting, incubating, conveying.

The project will build upon previous efforts and focus on building up the range of MF-based functionalities. Initial focus will be on the development of a MF device for generating a series of standards. An example given in the figure to the right, where 2 inlet species (red and blue) are mixed to generate a gradient.

The project includes designing in fusion 360, translating the design to a high-speed CNC, laminating and testing the devices.

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2026/2027 Projects (Chemical and Materials Engineering / Energy Systems)

Project code	ENG025
Project title	**Understanding Geothermal NCG Reinjection**
Discipline	Chemical and Materials Engineering
Supervisor(s)	Isaac Severinsen Brent Young
Contact details	Isaac.severinsen@auckland.ac.nz
Skills Needed	• A good understanding of heat and mass transfer • Some experience modelling using python or MATLAB

Project description

Geothermal power plants in New Zealand are increasingly reinjecting non-condensable gases (NCGs), such as carbon dioxide (CO2), rather than venting them to the atmosphere. The effectiveness of this approach varies between sites and depends strongly on temperature, pressure, gas composition, and geothermal brine chemistry.

This project will develop and validate a model for CO2 dissolution in high-temperature geothermal brines using data provided by an industrial partner. Initial work will focus on simple solubility models based on Henry's law, before extending the approach to account for salinity and non-ideal brine behaviour using more advanced thermodynamic models (e.g. Pitzer-type formulations). The outcomes will improve understanding of CO2 reinjection performance and support lower-emissions geothermal operation.

Project code	ENG026
Project title	**Geothermal Plant Modelling**
Discipline	Chemical and Materials Engineering
Supervisor(s)	Isaac Severinsen Brent Young
Contact details	Isaac.severinsen@auckland.ac.nz
Skills Needed	• Some experience modelling using python or MATLAB • Experience with Git highly valued

Project description

Geothermal power plants are a unique and valuable addition to New Zealand's electricity grid. They provide consistent power throughout the day and year and actually provide more power when it is colder. Currently modelling for the power plants is seen as an afterthought and once an expensive well is drilled the plant is designed and built quickly to meet investment timelines. A more robust model would be beneficial for dealing with differing well conditions once drilled or over time.

This project initially involves utilizing existing code for modelling these systems and validating them against plant data. Following this the code should be prepared for public release and made as robust as possible. This project does not involve a significant amount of thermodynamics/chemical engineering knowledge but does require coding prowess, preferably python.

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2026/2027 Projects (Chemical and Materials Engineering / Energy Systems)

Project code	ENG027
Project title	**Process-Microstructure-Phase nexus in thermally sprayed and laser clad coatings**
Discipline	Chemical and Materials Engineering
Supervisor(s)	Associate Professor Steve Matthews
Contact details	s.matthews@auckland.ac.nz
Skills Needed	• PASSION for materials science! And applying that to practical research • Practical, with great hands-on capabilities for lab work • All training to be provided but you must be keen to learn • Capable of working independently • Minimum of 2 years Materials science background

Project description

Passionate about materials science? Keen to work with cutting-edge materials science lab kit? Keen on applying your passion to solving real-world, practical research? Then this is for you!! Working across a range of research projects, you will be preparing and analysing next-generation thermal spray coatings for wear resistance as well as optimising the process parameters for NZ's only laser cladding machine that repairs components from hydro powder through to heavy industry.

Working in direct collaboration with Steve Matthews and his team of PhD students, you will be preparing samples for analysis using cutting edge metallography and analysing the coatings quantitatively using XRD, thermal analysis (DSC), microhardness, scanning electron microscopy, energy dispersive spectroscopy, electron back scatter diffraction and ion beam milling. You will pull together the analysis, together with reviews of the literature, to help define the metallurgical mechanisms in response to variations in process parameter settings. This work will have a direct, real-world impact, and lead to journal publications.

A snapshot of a real world research, ideal for those considering postgrad research, or with a deep passion for applied materials science.

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2026/2027 Projects (Chemical and Materials Engineering / Energy Systems)

Project code	ENG028
Project title	**Battery Thermal Management for Electric Vehicles**
Discipline	Chemical & Materials Engineering
Supervisor(s)	Amar Auckaili (PhD, Senior Lecturer) Reza Arjmandi (PhD, Lecturer)
Contact details	a.auckaili@auckland.ac.nz
Skills Needed	• Safe Lab practice • Data analysis skills (especially Excel) • Simulation skills (MATLAB and/or HYSYS) • Technical writing • Soft skills (time management, professional communication)

Project description

The performance of electric vehicles (EVs) depends substantially on the thermal efficiency of their battery packs. During operation, batteries generate heat that produces temperature non-uniformity across cells, adversely affecting vehicle performance, reliability, and lifecycle costs. Effective thermal regulation can improve heat dissipation rates and, consequently, overall EV performance. Battery Thermal Management (BTM) has therefore become a critical area of research.

Existing literature examines passive BTM systems incorporating phase change material (PCM) composites to enhance thermal regulation in EV batteries. However, persistent challenges including low thermal conductivity, inadequate long-term cycling stability, and integration complexity continue to constrain the practical deployment of PCM-based systems.

This research is structured around three milestones: (1) materials selection - identifying and evaluating at least two PCM-composites suitable for EV battery thermal management; (2) laboratory experimentation - characterising the thermal performance, mechanical stability, and structural integrity of selected PCM-composites; and (3) simulation - validating thermal performance and quantifying cycling durability.

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2026/2027 Projects (Chemical and Materials Engineering / Energy Systems)

Project code	ENG029
Project title	**Sustainable Thermochemical Energy Storage and Management**
Discipline	Chemical & Materials Engineering
Supervisor(s)	Amar Auckaili (PhD, Senior Lecturer) Reza Arjmandi (PhD, Lecturer)
Contact details	a.auckaili@auckland.ac.nz
Skills Needed	• Safe Lab practice • Data analysis skills (especially Excel) • Simulation skills (MATLAB and/or HYSYS) • Technical writing • Soft skills (time management, professional communication)

Project description

Thermochemical Energy Storage (TCES) using salt hydrates has received considerable attention as a promising approach to sustainable thermal energy management, owing to its high storage density and low thermal losses over extended periods. Despite these advantages, poor thermal conductivity remains a significant constraint.

This project addresses three interconnected research objectives:

Material Testing: To evaluate the thermophysical performance of salt-hydrate bio-composites - specifically magnesium sulphate combined with biochar - across repeated hydration/dehydration cycles.

Model Development and Calibration: To develop a transient computational model of a packed-bed reactor and calibrate it against published experimental datasets.

System Optimisation: To identify optimal operating conditions for integrating TCES into industrial HVAC systems.

The findings are intended to support future grant applications by establishing a rigorous technical foundation for scaled implementation of TCES technology.