THE UNIVERSITY OF SYDNEY

Waste Transformation Research Hub

Building research capacity to transform Australia's waste industry and deliver better outcomes for society

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Introduction

Australia's waste challenge

In Australia, as around the globe, more waste is being produced than ever before, due to increasing populations, increasing resource consumption per person and prevalance of single-use products.

According to the Australian Bureau of Statistics:

- the total annual volume of waste generated in Australia nearly doubled between 1997 and 2007, from 22.7 million to 43.8 million tonnes
- the annual volume of waste generated per person similarly increased over the same period, from 1.2 to 2.1 tonnes
- the total annual volume of waste sent to landfill also increased between 2001 and 2007, from 19 million to 21.3 million tonnes.

The need for waste technology innovations

These statistics clearly show that Australia cannot continue to rely on landfill as its primary means of dealing with waste. We need new waste technology innovations. In particular, we need new technologies for the sustainable processing of waste.

This doesn't simply mean disposing of waste in a less environmentally damaging manner. It means unlocking the value of this underused resource by converting it into safe, high-value chemicals and products for use in industry and homes. What we need to aim for is a circular economy, where materials production and end-of-life processing form a closed loop, with minimal ultimate waste. Sorting and processing waste at its source will maximise the efficiency of this value chain and reduce transport-related impacts.

One of the difficulties here is that Australia's waste is very diverse in types and characteristics, and is generated from a variety of sources and in a range of quantities. These variables represent significant challenges to the development of any single technology to process all of Australia's waste.

An industry-led research opportunity

The University of Sydney's world-leading researchers are already undertaking pioneering research in waste-management and waste-processing technologies.

We are now inviting key industry partners to join us in establishing a world-leading Waste Transformation Research Hub – a national-scale collaborative industry consortium that will support Australia's waste industry into the future and make significant contributions to resolving our national waste challenges, and ultimately those of the global community.

For industry this will mean facilitating the conversion of waste and other low-value streams into high-value chemicals and superior products and processes, driving sales growth and creating additional sources of raw materials.

For the wider community it will mean more efficient resource management and energy consumption, and new jobs and opportunities.

For Australia and the global community it will mean significantly reduced landfill, use of new raw materials, and associated environmental impacts.

"Australia's future waste industry needs deep transformation built on the concept of a circular economy."

Associate Professor Ali Abbas
School of Chemical and Biomolecular Engineering

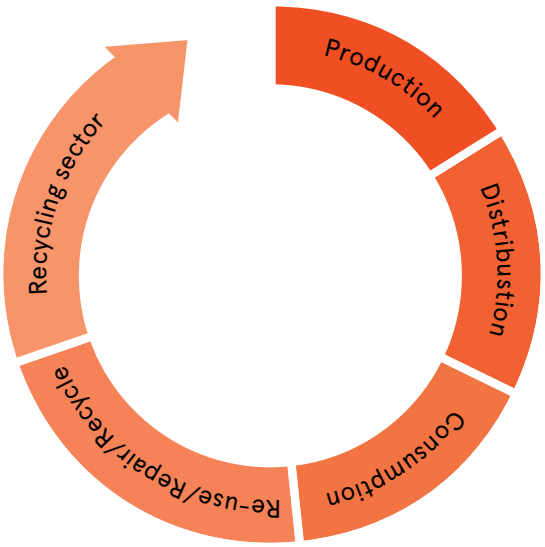
Looking ahead towards a circular economy

The proposed Waste Transformation Research Hub represents an opportunity for Australia to move to the forefront of waste technologies internationally. Its integration of advanced waste-management and waste-processing technologies – jointly driven by current industry leaders and world-class University of Sydney researchers – will generate economic, social and environmental benefits for our nation and for the international community.

Australia's future waste industry needs deep transformation built on the concept of a circular economy. Social and regulatory factors will encourage maximum reduction, reuse and recycling of waste, and innovative business models will incentivise product and packaging designers to maximise material recovery through whole-systems thinking.

Linear Economy

Circular Economy

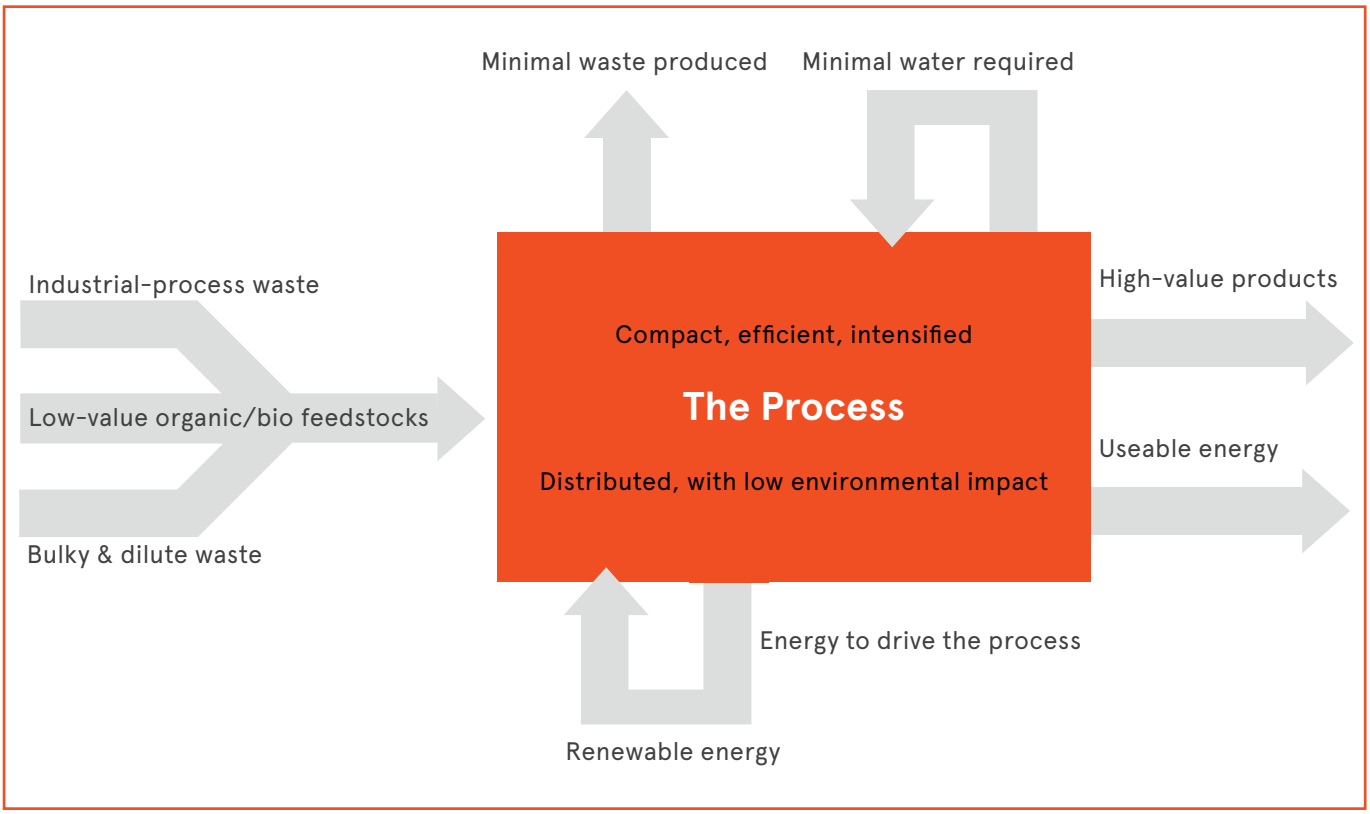


About the Waste Transformation Research Hub

The Waste Transformation Research Hub will develop new technologies to transform materials that are currently considered waste into energy and other high-value products.

Led by the School of Chemical and Biomolecular Engineering in the Faculty of Engineering and Information Technologies, the multidisciplinary research team will apply its existing expertise in process intensification (PI) – an approach that blends the economies of large-scale plants with the flexibility and effectiveness of micro-scale processes – to deliver higher manufacturing productivities and enhanced value for industry.

New and emerging PI technologies are already being used to build small, modular, energy-efficient, sustainable and safe plants that process waste at its source to produce high-value niche products. This can be done equally well in urban and regional areas.



A conceptual representation of the proposed waste-processing platform.

Involvement of industry

Our consultations with industry over the past two years have identified a key need for transformative waste research.

Feedback received from large and small businesses across all sectors of the economy – combined with the success of our 2015 industry–University workshop A New Approach to Manufacturing High-value Products by Process Intensification – have informed our decision to establish a national-scale research hub that will transform and foster further Australian innovation in waste processing.

Proposed structure and funding model

The Waste Transformation Research Hub will bring together expertise from industry, researchers and leading academics to jointly contribute to transforming Australia's waste industry.

The University will seek government support under the Australian Research Council's Industrial Transformation Research Hub (ITRH) program.

Other funding sources will also be sought, in order to facilitate the building of substantial capabilities that will provide Australian businesses with access to expertise and knowledge, as well as advanced research facilities, directed towards developing local solutions for future sustainable manufacturing and business operations.

Delegates at our 2015 industry-University workshop 'A New Approach to Manufacturing High-value Products by Process Intensification'.

World-leading research focus

University of Sydney researchers will partner with researchers from other universities and research organisations, including those from the University of Technology, Sydney (UTS).

The research will focus on applying advanced process intensification principles to deliver portable, scalable manufacturing solutions and technologies to waste transformation in order to add value to products derived from waste.

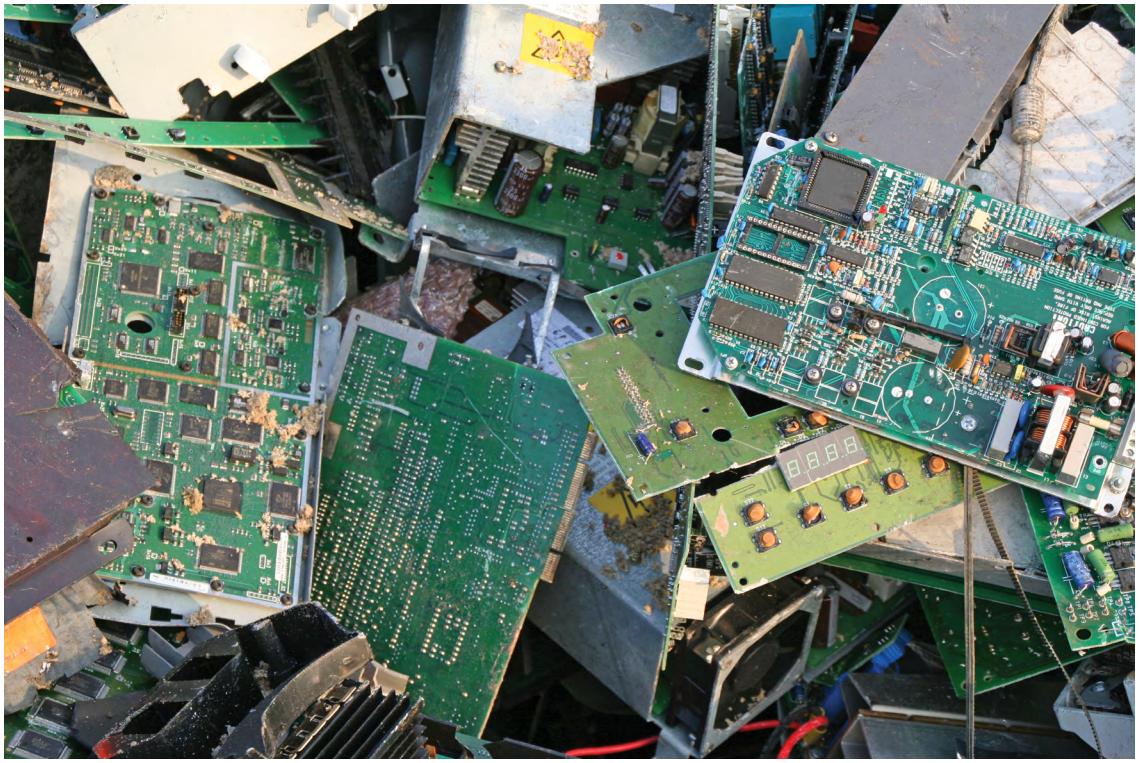
It will centre on the following four themes:

- Waste water
- Organics and municipal solid waste
- Industrial waste
- e-Waste.

Multidisciplinary expertise

Waste transformation requires a multidisciplinary approach. The Waste Transformation Research Hub will draw on the expertise of University of Sydney researchers in the School of Chemical and Biomolecular Engineering, the School of Mechanical Engineering, the School of Chemistry, the School of Physics, the Faculty of Agriculture and Environment, the Business School and the Sydney Environment Institute. Contributions from other faculties, schools and centres, including the Faculty of Humanities and Social Sciences and the School of Psychology, are also expected.

Expertise will also be drawn from UTS's Institute for Sustainable Futures, and from other organisations including CSIRO, Environmental Protection agency, Bioenergy Australia and the Australian Waste Management Association.



Electronic Waste (e-Waste).

Research environment

Research will be led by the School of Chemical and Biomolecular Engineering at the University of Sydney, home of the Australian Research Council–funded Industrial Transformation Training Centre in Food Process Engineering, which houses a number of state-of-the-art pilot plants including:

- a hydrothermal processing plant for the production of liquid biofuels
- a methane reformer built on the University's patented and world-acclaimed microchannel heat exchanger technology
- a bubble column fermenter
- a patented spray-dryer
- a multipurpose reactor/crystalliser facility.

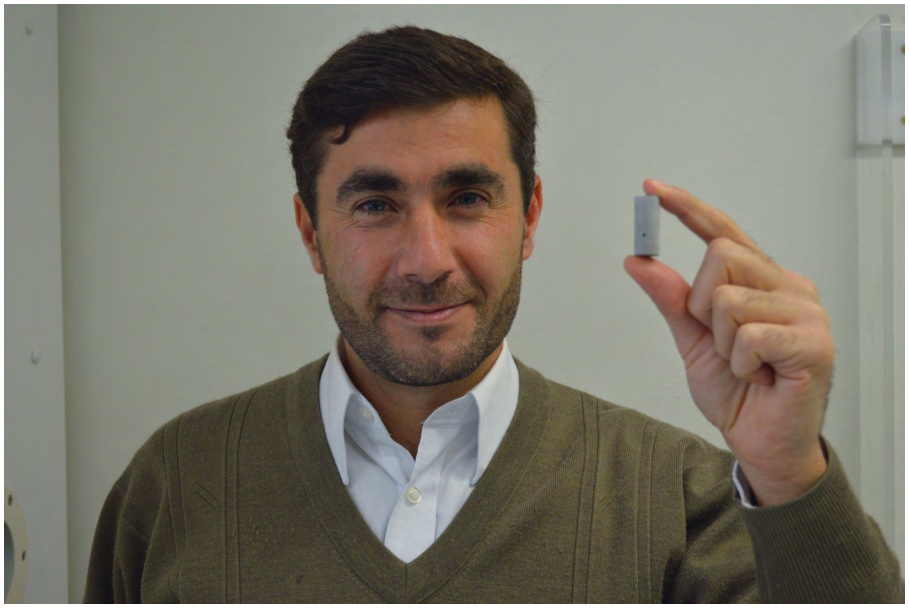
These facilities are uniquely placed to enable the Waste Transformation Research Hub to conduct internationally leading research into waste transformation. Collectively, these facilities offer the key state-of-the-art infrastructure and equipment critical to support this multidisciplinary research.

Access will also be provided to advanced microanalysis facilities at the Australian Centre for Microscopy and Microanalysis and at Sydney Microscopy and Microanalysis, both also located on the University of Sydney's Camperdown campus. These core facilities are among the largest and most comprehensive of their kind in the world, and offer access to leading technical expertise.

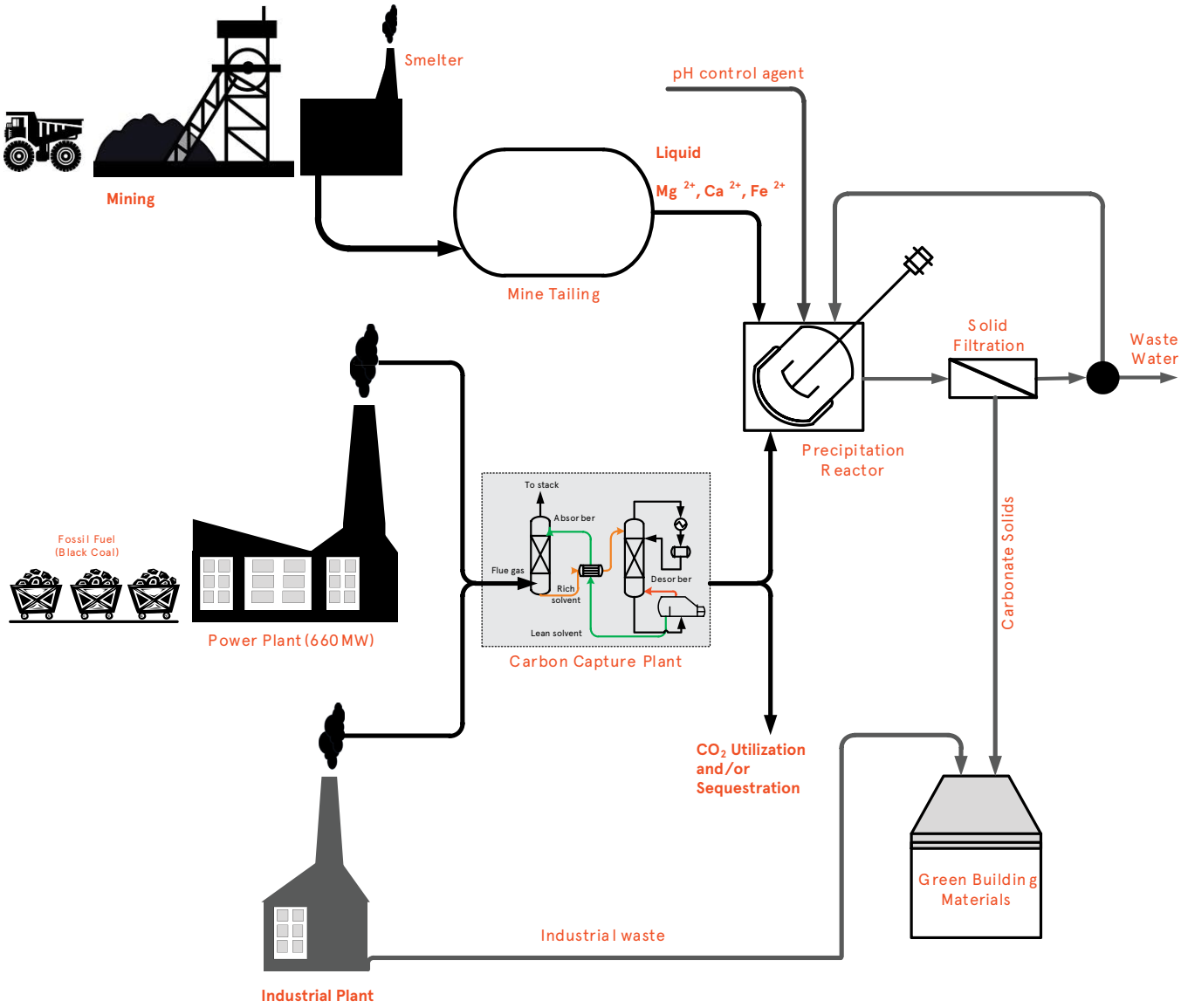
Professor Haynes and the University of Sydney hydrothermal processing plant.

This continuous-flow kilogram -scale research facility is the first of its kind in Australia. It converts organic and other solid matter into fuels and chemicals under hydrothermal conditions, submerging them in water up to 300 degrees Celsius and subjecting them to pressure equivalent to up to 250 atmospheres. The plant has converted various biomass feeds including algae into bio-oils.

The hydrothermal pilot plant at the University of Sydney's School of Chemical and Biomolecular Engineering.



Associate Professor Ali Abbas with a sample of his new cement blend. This research transforms fly ash and carbon dioxide wastes from power plants into future sustainable construction materials.



Conceptual approach to the use of industrial waste in the design and manufacture of new green building materials for the construction industry.

For more information
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