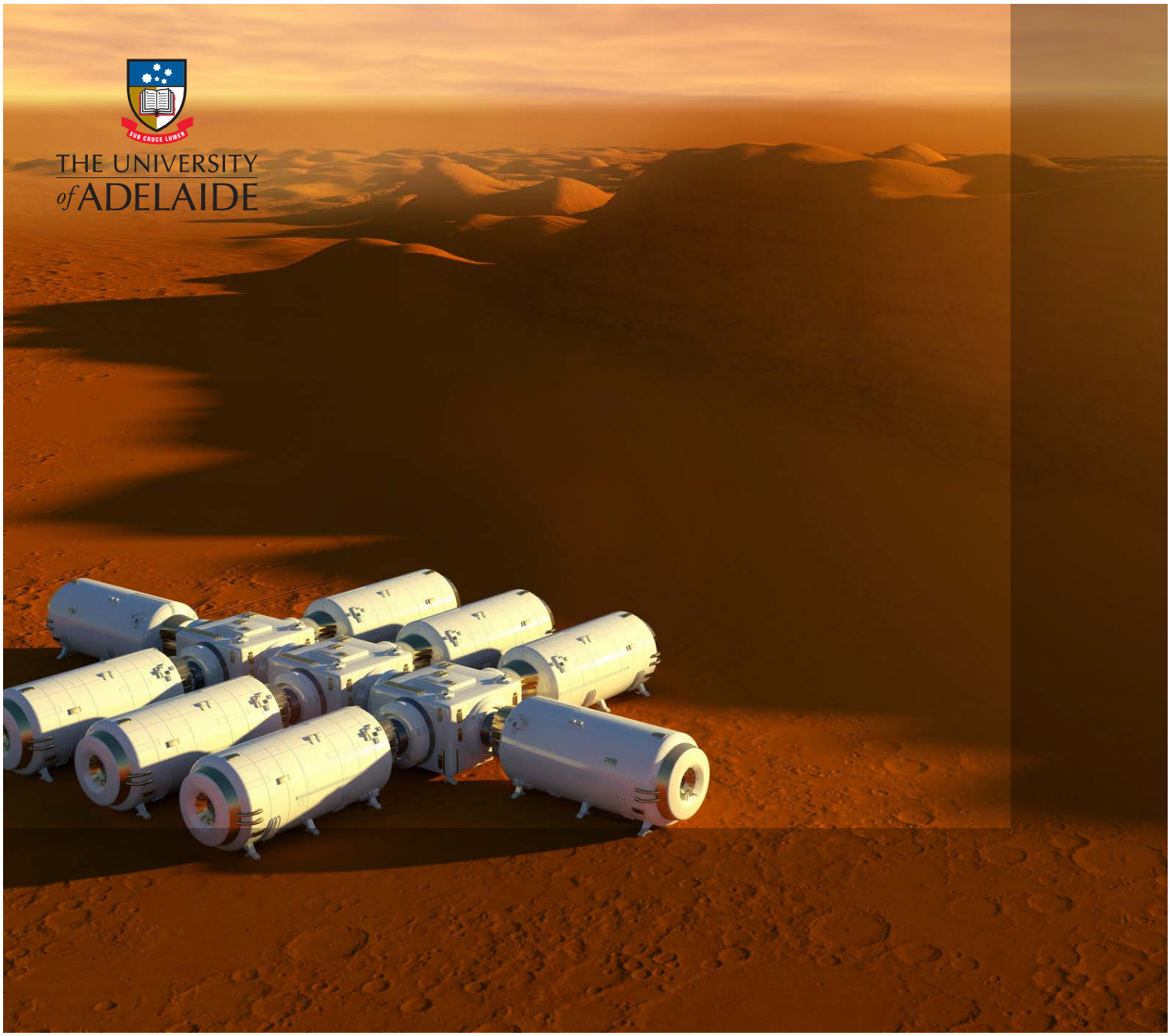


ATCSR

Andy Thomas Centre for Space Resources

ecms.adelaide.edu.au/atcsr

WHO WE ARE

The Andy Thomas Centre for Space Resources (ATCSR) sets a vision for a globally unique education and research facility capable of addressing the challenges faced by long term planetary exploration, while ensuring the near-term application here on Earth.

Successful long-term space exploration requires a fundamental rethinking of the technologies, processes and infrastructure required to ensure continued and sustainable access to the energy, fuels and resources necessary for off-world operations.

The Andy Thomas Centre for Space Resources (ATCSR) is the University of Adelaide's hub of sustainable planetary resource research and education, building a unique ecosystem for space resources research and commercialisation. It is focused on identifying solutions and developing technologies supporting sustainable, self-sufficient resource exploration, extraction, processing and utilisation in extreme environments, on and off planet Earth.

The Centre aims to:

- Connect the University of Adelaide's specialist capabilities in Artificial Intelligence, Autonomous Systems, Mining Engineering, and Advanced Materials and Manufacturing to global efforts in off-world exploration and habitation;
- Combine additional specialist capabilities from across the University to address the end-to-end value chain for sustainable off-world resource utilisation including energy and fuel, health and medicine, and food production;
- House a suite of cutting-edge multi and interdisciplinary laboratories, test environments and digital capabilities that integrate into the global space industry and exploration agenda;
- Apply ISRU technologies, systems and processes to remote operations and regional communities here on Earth;
- Develop a globally unique education and research facility designed to link students with the emerging space sector, providing an integrated learning environment supporting both industry and research career pathways; and,
- Create a new, industry-focused ecosystem that fosters space and resource-related research, education and commercialisation pathways into the space and resources sectors.

The Centre is named after Dr Andy Thomas AO—Australia's first astronaut, aerospace engineer and University of Adelaide alumni.

In-Situ Resource Utilisation

The In-Situ Resource Utilisation (ISRU) concept, as pioneered by NASA, addresses the reliance on Earth- based materials for long term space exploration by proposing an off-world, self-contained resource chain covering the exploration, extraction and utilisation of the resources required for sustained space operations.

This concept leads the way for the construction of habitation modules, industrial facilities, laboratories and transportation solutions utilising off-planet resources and materials. Success in ISRU operations will be fundamental to successful long-term habitation of other planetary bodies such as the Moon and Mars.

Challenges

The major challenges for sustainable planetary resource exploration include:

- What resources exist on planets and near-earth objects and how do we identify, assess and model them?
- How do we extract these resources and process them in a responsible, efficient and sustainable way?

- What technologies and processes do we need to successfully manufacture new materials for off- planet construction?
- How do these resources become new essential products for life to prosper on new worlds?
- How do we generate and store energy and fuels, grow food, maintain equipment and ensure safe and reliable operations on other worlds?
- What are the legal frameworks required to underpin commercially viable exploration and operations?

Addressing these challenges also provides opportunities for developing new technologies that can underpin long term, sustainable, resource exploration and processing in remote locations here on Earth.

National Space Agenda

Space-related research, products and services have translation to virtually every sector of the Australian economy with critical linkages to sectors such as mining, manufacturing, agriculture, communications, transport and logistics.

In May 2018, the Federal Government announced the establishment of the Australian Space Agency (ASA), focused on supporting the long-term development of space technologies, grow domestic space industry and secure Australia's place in the global space economy. Later that same year, the ASA announced it was locating its Mission Control Centre and Space Discovery Centre was at Lot 14, in the heart of Adelaide and its emerging high tech space precinct, and directly adjacent to the University of Adelaide.

The Centre seeks to leverage the University of Adelaide's strategic engineering and technological capabilities to support the nation's endeavours in space; integrating with the ASA's vision of transforming and growing a globally respected Australian space industry, lifting the broader economy, and inspiring and improving the lives of Australians.

The Centre's vision aligns specifically with the Australian Civil Space Strategy, focused on the National Civil Space Priorities of robotics and automation on Earth and in space. It incorporates key research capabilities across Automation and Control, Electrical, Civil and Mining Engineering, Computer Science and Machine Learning, Chemical Processing, Agriculture and Material Manufacturing.

Locally, the Centre will contribute to the development of priority sectors for South Australia, in particular the technology, mining, agriculture and education sectors. The people, products and services supported by the Centre will help create new job opportunities and foster new business enterprises.

These new enterprises will be supported and enhanced through the University of Adelaide's ThincLab entrepreneurship ecosystem and in close affiliation with the space ecosystem being developed at Lot 14.

Collaboration

The Centre is the University of Adelaide's focal point for the engineering, science and technology elements of ISRU.

Students, researchers and industry partners will also have direct access to the University's space and resources ecosystem, gaining the opportunity to interact with imbedded industry partners, world leading university research capabilities, and university research collaborators.

This includes University of Adelaide research institutes, centres and schools, such as:

- The Institute for Minerals and Energy Resources, developing new technologies supporting energy production, deep mining and mineral processing;
- The Australian Institute for Machine Learning, applying machine learning, artificial intelligence and robotic vision to the next generation of autonomous and remote operations;
- The Institute for Photonics and Advanced Sensing, where future generations of high precision, high sensitivity optical sensors are created;

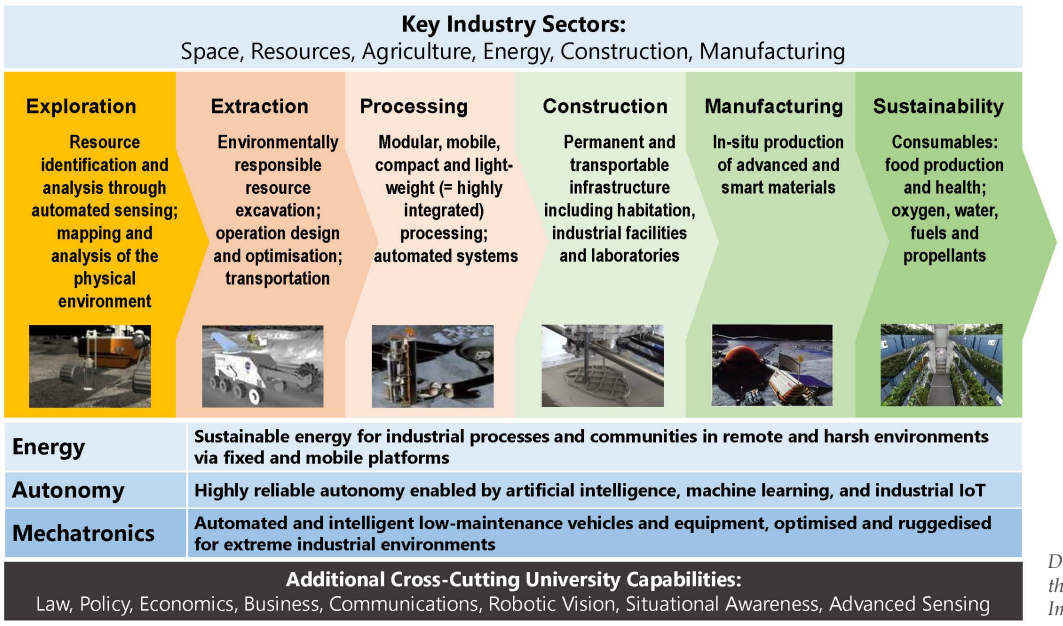


Diagram showing the six operational and three supporting modules of the ATCSR. Image Source: NASA.

OUR VISION

- The Centre for Energy Technology, developing renewable, sustainable and future energy technologies; and,
- The Centre for Materials in Energy and Catalysis here new materials and catalysts are created.

The Centre will also link to National and International programs and initiatives such as:

- The ASA's Robotics, Automation and Artificial Intelligence (AI) Command and Control Centre;
- CSIRO Space Technology Future Science Platform;
- The Colorado School of Mines, Center for Space Resources;
- The NASA and European Space Agency ISRU programs.

The Centre is also located adjacent to South Australia's Lot 14 Creation and Innovation Neighbourhood, home of the ASA's Space Discovery Centre and Mission Control, and host to companies such as Inovor Technologies, Neumann Space and Myriota.

Industry Partners

A key driver of the Centre will be an on-going engagement with industry. The University is working with foundation partners Dassault Systèmes (3D Experience engineering and design software), CAPRA Robotics autonomous vehicles and space laboratory specialists Space Tango.

Centre Growth

As ATCSR activities grow in scope and impact, it will connect to other interdisciplinary teams and researchers from across the University. This new network will help develop the technical and transformative business models, legal policy, and economic understanding for sustainable space mining activities. It will connect with other relevant national and international initiatives and activities focused on space resource utilisation.

Research and Education

The Centre will be a focus of the University of Adelaide's space research and education ecosystem, closely supported by existing University strengths in minerals and energy resources. It will extend and diversify the research and education capacity of the core science, engineering, computer science, mathematical, legal and economics disciplines.

Students and researchers will have the opportunity to learn and innovate in a representative physical and virtual environment, connecting with world leading engineering and technology in the areas of sensing, advanced materials and processing, construction, big data, artificial intelligence and robotics, decision making and autonomy, and human factors.

The education program aligned with the Centre will bolster key programs in mining engineering, minerals processing and metallurgy as well as link to complimentary fields such as construction, advanced manufacturing, process engineering and energy.

Research undertaken within ATCSR will target the development of synergistic proprietary technologies for remote, sensitive and extreme environments, both in space and on Earth.

The underlying mission of the Centre is to support long-term human presence beyond low-Earth orbit—and this is reflected in the Centre's overarching structure.

Centre Structure

The Centre will be built around nine space research and education modules that directly align with the broader ISRU value chain as proposed by agencies such as NASA (Figure 1).

The six operational modules will use state-of-the-art equipment in conjunction with an end-to-end 3D Digital design environment and VR/AR visualisation tools to design, develop and model the off-world facilities of the future.

The three enabling modules provide space adapted technology solutions critical to the success of all of the operational modules.

The ATCSR facilities will support research excellence and foster a range of educational opportunities. It will act as a beacon for students, locally and internationally, who are seeking to engage with the rapidly evolving space industry, and eager to gain the knowledge and skills required to support the transformation of the resources sector on Earth.

The nine ATCSR modules are:

Operational Modules:

Resource Exploration Module

This module will focus on aspects of resource identification and analysis, automated sensing, mapping and analysis of the physical environment (geography and sub-surface).

Resource Extraction Module

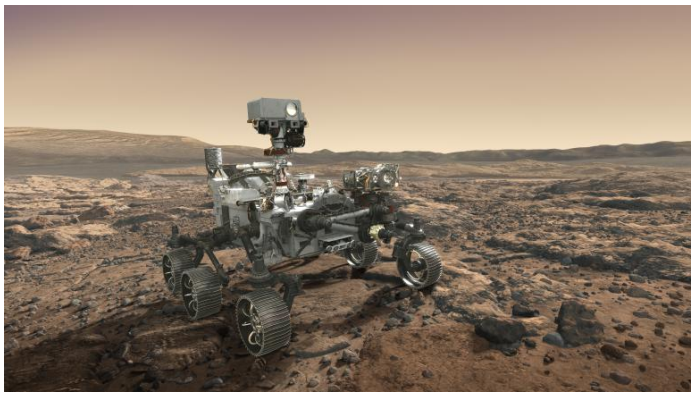
This module will examine techniques and processes for environmentally responsible resource excavation, transportation, operational design and optimisation.

Resource Processing Module

This module performs chemical and other processing of extracted resources. Continuous-flow processes are commonplace in space already, allowing the design of modular, mobile, compact and light-weight automated processing systems. This will help drive a broader engagement agenda in complementary fields such as Space Medicine.

Manufacturing Module

This module will focus on material production including the specialist processes and infrastructure required for the fabrication of advanced and smart materials.



Mars 2020 Perseverance Rover. Image Source: NASA/JPL/Caltech.

Construction Module

This module will address civil engineering and architecture challenges including the construction of permanent and transportable infrastructure (including habitation, industrial facilities and laboratories).

Sustainability Module

The sustainability module focuses on harnessing the fundamental elements required to sustain life and maintain operations in space. This includes the production and storage of oxygen, water, energy, food, fuels and propellants.

Support Modules:

Energy Module

This module will focus on the provision of sustainable energy processes, systems and technologies for industrial processes and communities in remote and harsh environments. This includes energy solutions operating on both fixed and mobile platforms.

Autonomy Module

This module will develop highly reliable autonomous systems and technologies enabled by artificial intelligence, machine learning, and the Industrial Internet of Things (IIoT).

Mechatronics Module

This module will develop the automated and intelligent, low-maintenance vehicles and equipment, optimised and ruggedised for extreme industrial environments that will be required to precede and accompany humans back to deep space.

Using these modules as a framework, the ATCSR will drive space research and education that both supports the translation of current practices and technologies as well as the development of new ones. This mix will help drive a new, space-focused industrial sector combining all aspects of engineering, manufacturing and energy generation.

Though ISRU has a long-term focus and sets goals for coming generations, the knowledge, skills and technologies developed along this pathway will be of great benefit to many industries and help transform operations, practices and processes here on Earth.

Centre Leadership

Centre Director

Associate Professor John Culton has extensive international experience within defence policy, security cooperation, space, and intelligence sectors, as a senior diplomat and US Department of Defense leader.

Most recently, John has been focused on the role of technology, policy, and law in the coming commercial development of the Earth-Moon system.

Centre Research Director

Professor Volker Hessel is an internationally recognised research leader in the field of flow chemistry and process intensification and their application to space-based industries such as continuous processing, manufacturing and pharmaceutical engineering.

Module Leads

In addition each module will be led by a University of Adelaide Chief Investigator with strong links to both the research community and industry.

Be involved

The Centre is actively seeking partners interested in realising ATCSR's vision for future sustainable resource exploration utilisation – both in Space and on Earth.

Please contact us for more information.

Enquiries

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KAURNA ACKNOWLEDGEMENT

We acknowledge and pay our respects to the Kaurna people, the original custodians of the Adelaide Plains and the land on which the University of Adelaide's campuses at North Terrace, Waite, and Roseworthy are built. We acknowledge the deep feelings of attachment and relationship of the Kaurna people to country and we respect and value their past, present and ongoing connection to the land and cultural beliefs. The University continues to develop respectful and reciprocal relationships with all Indigenous peoples in Australia, and with other Indigenous peoples throughout the world.

FURTHER ENQUIRIES

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