PATREC

ANNUAL REPORT 2023

Planning and Transport Research Centre

April 2024

FINAL

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Planning and Transport Research Centre

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Version control

FINAL

About PATREC

The Planning and Transport Research Centre (PATREC) is a collaboration between the Government of Western Australia and local universities, constituted to conduct collaborative, applied research and teaching in support of policy in the connected spaces of transport and land use planning. The collaborating parties are: The University of Western Australia, Curtin University, Edith Cowan University, Department of Transport, Main Roads Western Australia, Western Australian Planning Commission and the Western Australian Local Government Association.

Publisher

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Contents

KEY ACHIEVEMENTS IN 2023

2 core projects completed with high impact

- Identifying opportunities to address transport disadvantage in Perth
  "…[report] of high standard, clear interpretation, and contextualisation of findings…Recommendations were targeted and well-grounded… TD score is an important step in identifying locations and at-risk populations in Greater Perth"
- Integrated IoT, computer vision and machine learning technologies for smarter bridge health monitoring and prediction
  "… successfully demonstrated that advanced algorithms and technologies can inexpensively help Road Authorities to monitor bridges and their performance. PATREC collaborating with UWA and Curtin Universities has immensely contributed to this research…"

2 external projects completed

- Australian Transport Research Cloud - AURIN/Australian Research Data Commons
- AURIN national transport domain specialist

3 climate action projects commenced

- Feasibility of battery-electric buses for regional school bus services
- Accounting for carbon in the planning for new residential suburbs
- Mapping the Circular Economy of WA: Monitoring the contributions of circularity towards achieving Net Zero – Stage 1

5 core projects commenced

- Impacts of e-rideables on the transport task
- Micromobility and freight – exploring opportunities
- Transport mode choice development using PATHS data
- Sustainable last km food and beverage delivery system
- Evaluation of road safety treatments

External projects substantially progressed

- Improved Roundabout Modelling using Drone Video analytics
- Innovation Connection (Metrocount) – Video analytics application
- Optimising video analytics for traffic data collection and calibration incorporating fixed camera videos
- ARC Linkage participation - Map My Say
- AI-assisted Model Calibration for Real-time Traffic Simulation

External project commenced

- Potential for carbon capture and reduced GHG emissions through innovative asphalt pavement design – use of bio char waste

New program: climate action in transport and land use planning underway

- Program Leader appointed
- Research Advisory Committee (CARAC) operational

Australasian Transport Research Forum (ATRF) 2023 conference organised in Perth

- PATREC local organising committee
- successfully held 29 November to 1 December 2023
- record attendance
- positive feedback from post-conference survey by IPSOS

PATREC Director appointed to the AURIN Scientific Advisory Committee for 3 years

3 external grant applications, successful

- ARC Linkage Infrastructure, Equipment and Facilities 2024: National Cycling Data and Analysis Platform
- ARC Industrial Transformation Training Centre for Automated Vehicles in Rural and Remote Regions

New external project grant application progressed

- National Critical Research Infrastructure Strategy (NCRIS), AURIN WA Node to support climate action in transport and land use planning research
- AURIN has allocated $620k for the WA Node at PATREC: data and tools for climate action research
- Leverage from WA State Gov and unis being coordinated by UWA – business case to JTSI for budget submission

9 news articles published, mostly in conjunction with iMOVE CRC

5 peer-reviewed journal articles published, related to PATREC research

11 conference presentations made at the ATRF 2023, showcasing PATREC research

16 presentations made at other conferences/events

1 PhD graduated, 2 PhDs in progress (PATREC staff)

Stakeholder satisfaction indicator of 80% achieved

Academic return on investment (ROI, 5-year, project-based): 2.7 (UWA: 2.9; Curtin: 2.4; ECU: 2.0)

Research income (excl. core subscriptions): $1,980,017

1. PURPOSE

The primary purpose of this report is to provide an update of activities conducted in 2023 with a focus on outputs and outcomes achieved. After providing a summary of completed research projects, the report on progress achieved in relation to commencing and current projects core and external projects, highlighting the newly commenced climate action in transport and land use planning projects. Knowledge transfer activities are then reported focussing on research outputs, communication at connection opportunities and events, teaching and training and research impact. Operational aspects of staffing, resources and governance needed to undertake the research is covered next with the report culminating with a summary table of key performance indicators.

2. RESEARCH PROJECT ACTIVITY

2.1. Projects completed

Two substantive core projects completed:

- Identifying opportunities to address transport disadvantage in Perth
- Integrated IoT, computer vision and machine learning technologies for smarter bridge health monitoring and prediction

One major external project was completed:

- Australian Transport Research Cloud - AURIN/Australian Research Data Commons (Uni Melbourne, UWA, Curtin) ($450k)

The key findings of the completed projects are summarised next.

Identifying opportunities to address transport disadvantage in Perth (completed)

PATREC-iMOVE Core Project ($99,294; January 2022 – December 2023; iMOVE, DoT, UWA, Curtin)

To enhance the understanding of transport disadvantage (TD) through developing a score to measure and compare the relative risk of TD across locations in Greater Perth:

- Develop and apply an indicator framework comprising the most appropriate measures of TD risk;
- Identify, characterise, compare and map the risk of TD across Greater Perth; and
- Recommend opportunities for action by the government and other key service providers.

A TD risk score was developed to measure the relative risk level of TD for different locations across Greater Perth. The resultant TD risk score applied a combination of accessibility and at-risk population data, normalised for comparative purposes, to be used to identify target locations for further consideration and action.

The locations with the highest (least favourable) overall TD risk scores, relative to all other Greater Perth SA2, were identified by the research.

These risk scores generally reflected:

- high representation across the ten identified most at-risk population groups;
- comparatively large overall population sizes; and
- moderate-to-low relative access to all key participation opportunities.

The locations with the lowest (most favourable) overall TD risk scores, relative to all other Greater Perth SA2, were identified by the research.

These risk scores generally reflected:

- low levels of representation across the ten identified most at-risk population groups;
- varying overall population sizes; and
- high relative access to all key participation opportunities.

Three risk score bands were identified, organised into inner, middle and outer zones across Greater Perth. The locations with the highest risk scores are all located within the middle zone. Comparatively, accessibility is generally lower in outer zone locations; however, outer locations have comparatively small population sizes, which significantly moderate scores.

The research produced 11 specific recommendations to guide policy-makers to further action.

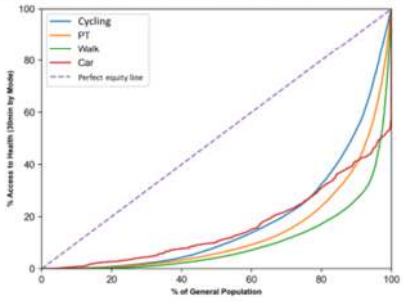
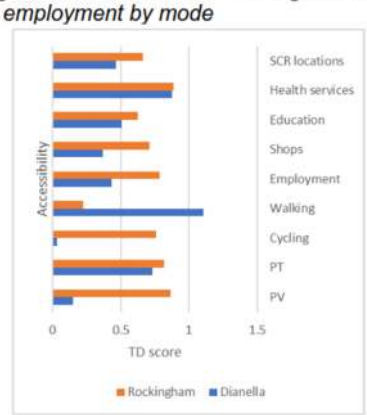


Figure 21 Lorenz curve showing accessibilit to employment by mode



Integrated IoT, computer vision and machine learning technologies for smarter bridge health monitoring and prediction (completed)

PATREC-iMOVE core with supplementary funds provided by Main Roads ($270,407; November 2021 – September 2023; iMOVE, UWA, Main Roads, Curtin)

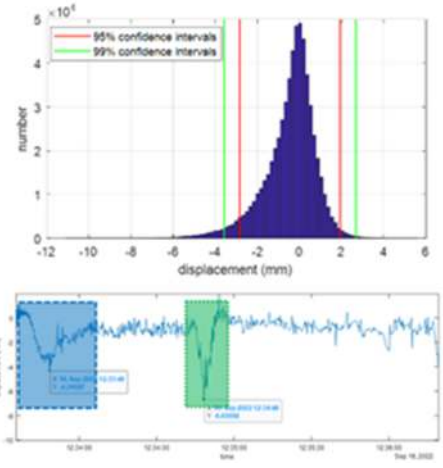
To investigate the feasibility of using an integrated package of IoT, computer vision and machine learning technologies to support smart bridge health monitoring and prediction:

- Develop IoT technology-based solutions for collecting, visualizing and transmitting vibration response data;
- Develop computer vision-based solutions for measuring bridge displacement under a range of traffic loads;
- Develop an integrated proof-of-concept predictive model based on ML techniques for predicting bridge displacement under heavy traffic loads; and
- Make recommendations on new techniques for efficient bridge monitoring, the wider roll-out of the technology for bridge health monitoring and prediction and suggest the next steps.

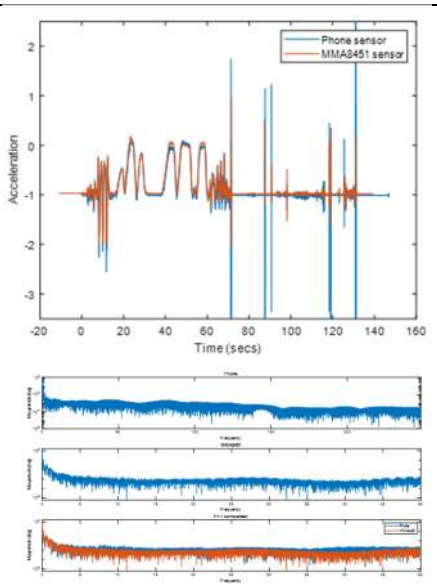
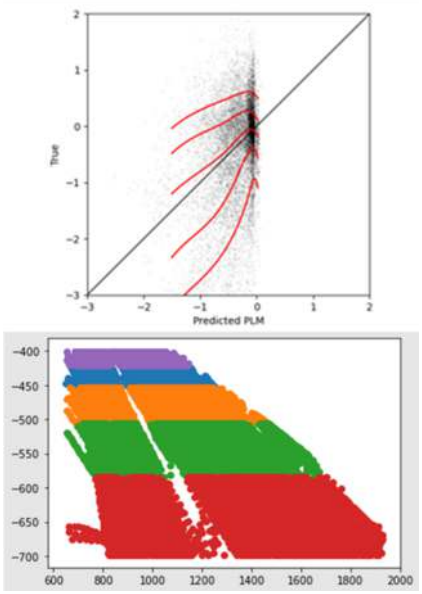
To deliver on the objectives, using the Stirling Bridge, Fremantle, as the test site, the research was conducted in three parts, each relating to an aspect of the essential indicators for bridge health monitoring: bridge displacement, vibration characteristics and traffic load.

Bridge displacement is important to understand to determine how the structure responds to different traffic loads, especially heavy loads. However, conventional contact-type displacement sensors, such as the linear variable differential transducer (LVDT), require a stationary reference point that is often difficult to find in the field. Additionally, their short measurement range of less than 1 meter limits their application to large-span bridges. As an alternative, a computer vision-based method was tested.

Lab tests demonstrated good agreement with LVDT sensor data. Due to the limited range of LVDT, direct on-site validation was challenging, and only indirect checking of the data was possible. The observations were in line with the displacement influence line theory, and the top ten detected displacements correspond to heavy traffic patterns recorded by the traffic camera, indicating the reliability of the collected data.



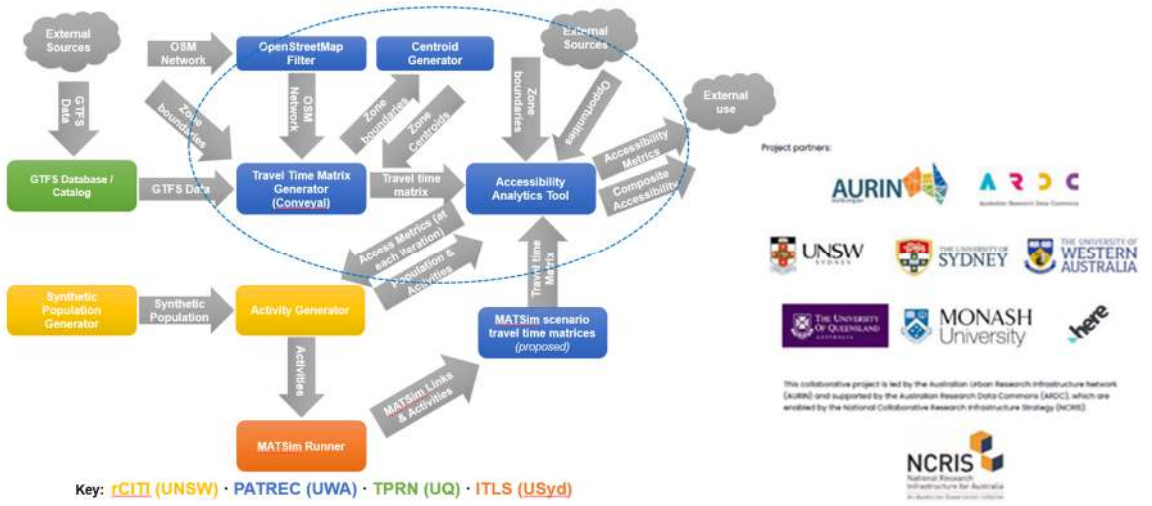
During the test, the physical dimensions of the bridge were needed to translate the number of pixels in the video to real distances. As the side of the bridge was inaccessible for physical measurement, design drawings were used instead. The field test also identified that environmental factors such as wind-induced camera motion and lighting conditions could affect the accuracy of results.

Vibration data can be used to detect variations in the bridge's natural frequency over time, serving as an alarm for potential structural damage. A prototype IoT unit was built to measure bridge vibration using an accelerometer. The data was successfully transferred to the AWS S3 cloud storage over an IoT link, and a dashboard was created for accessing the collected accelerometer data. A comparison with an industry-grade wired sensor showed that the chosen IoT sensor lacked sufficient resolution, leading to the purchase of a better model. Although the field test opportunity was missed, lab tests demonstrated comparable results between the new IoT sensor and a smartphone accelerometer. The prototype has overall demonstrated the cost-effectiveness of IoT for collecting bridge vibration data when IoT data coverage is available. Further considerations include addressing power supply issues in remote areas and determining optimal attachment locations for the unit on the bridge.	
The ML part of the project set out to develop proof-of-concept models to predict the bridge's vibration and displacement responses given the observed traffic loads from videos. Both tasks were proven to be difficult, although the vibration prediction achieved comparatively better results. The available literature indicates the inherent difficulty of mathematically inferring bridge displacement from vibration data. Extensive testing was conducted using various ML models, yet the challenge persisted, further confirming the complexity of the task. The 'phantom displacements' in the data also contributed to the difficulty. Nevertheless, the model estimated influence curve seemed reasonable, which suggests that it captured some of the underlining mechanisms. Interestingly, combining the vibration data with traffic videos did not increase accuracy.	

ATRC: PATREC contribution: ADAPT Accessibility Tool (completed)

PATREC External Project ($450,000; December 2020 – June 2023; NCRIS, AURIN, UWA, Curtin)

To provide transport researchers, planning and policy makers from academia, government and industry, with a platform that is sustainable and offers data and tools to accelerate transport research and impacts across Australia into the future. Aim is to provide a common platform (data, storage, compute and tools) to support the needs of the Australian transport research community



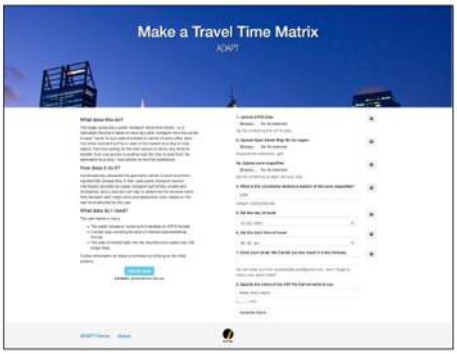
Extract from ATRC Final Report, 10 July 2023:

PATREC tools developed, tested and containerised as a part of this project:

- Accessibility Analytics Service: derives metrics and visualisations from opportunity, travel time and related data
- Travel Time Matrix Generator: a wrapper around v1.5 of OpenTripPlanner to provide a simpler and more efficient way to generate zone-to-zone travel time matrices for a variety of travel modes, when supplied with transport network information
- Centroid Generator: a tool to allow users to generate population-weighted centroids of larger regions/areas from data regarding congruent smaller regions/areas

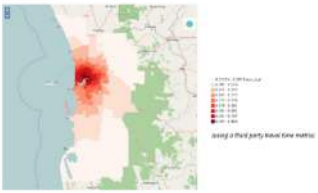
The tools were tested in PATREC's Transport Disadvantage project to generate relevant accessibility measures. Further work beyond the scope of the project has been undertaken to add in additional features, such as competitive accessibility and additional impedance functions.

Related publication: Reed, T. W., Olaru, D., Sun, C. & Biermann, S. (2023). Adapting ADAPT: a service based Accessibility toolkit. Australian Transport Research Forum 2023.



SAMPLE OUTPUT: JOBS BY PT (30MIN PERTH)

SAMPLE OUTPUT: JOBS BY CAR (30MIN PERTH)



2.2. Core research program projects progressed

Aside from the two completed projects as described in the previous section, of the remaining four projects comprising the 2021-23 program of core-funded research projects, all but one progressed to the satisfaction of project steering committees, the PATREC Research Advisory Committee and the Board, with most due to be completed by mid-2024 (Table 1). One 21-23 project was behind schedule due to continued resourcing, communication and project management issues, with an agreed plan in place to get the project back on track. The last remaining incomplete project of the 19-21 program, Enhanced Vehicle Detection is still delayed due to sensor installation delays, which Main Roads has been pushing to implement.

The 23-25 program or research is well established, with five project agreements executed and projects commenced, one intentionally postponed due to other project completion priorities, one being replaced by an alternative project and one on hold while the team addresses issues with their existing project.

Table 1: Progress of core projects (19-21, 21-23 and 23-25 programs of research)

Project Title	Key Agency	Research Lead	Uni/s	Progress as at 31 December 2023
2021-23 core program of research				
Transport Environment and Kids… 15 Years On	DoT/DPLH	Gina Trapp	UWA	On track. Completion due: 30 July 24
Identifying opportunities to address transport disadvantage	DoT (DoC)	Sae Chi	PATREC, UWA, Curtin	Completed
Freight network to support NW freight task	DoT/DPLH	Kerry Brown	*ECU*	Behind schedule
Integrating AI and IoT based Bridge Health Monitoring	Main Roads	Jun Li	Curtin, UWA	Completed
Model of delay at traffic signals (Value Driver)	Main Roads	Chao Sun	PATREC/UWA	On track. Completion due: 29 April 24
ML models for road maintenance investment decision making	Main Roads	Chao Sun	PATREC	On track. Completion due: 31 March 24
2019-21 core program of research				
Enhanced vehicle detection at Traffic Signals and Smart Freeways	Main Roads	Mohammed Bennemoun	UWA	Behind schedule. Awaiting sensor installation completion by Main Roads. IMOVE concerned.
2023-25 core program of research				
Automated intersection parameter measurement using aerial photography and computer vision - pilot	Main Roads	Chao Sun	PATREC	Postponed start to April/May
Evaluate the efficiency and economic benefit of spray injection pothole repair	Main Roads	Yuxia Hu	UWA	MR in process of identifying alternative project
Evaluation of road safety treatments - road safety trial design and evaluation using video analytics	Main Roads	Chao Sun/ Paul Roberts	UWA	Agreement executed.
Impacts of e-rideables on the transport task in WA	DoT	Doina Olaru	UWA/Curtin	Agreement executed. Project commenced
Micromobility and freight – exploring opportunities in WA	DoT	Courtney Babb	Curtin	Agreement executed. Project commenced
Transport mode choice development using PATHS data	DoT	Brett Smith	UWA/Curtin	Agreement executed. Project commenced
Sustainable last km freight and parcel delivery system - retail and parcel delivery	DPLH	Kerry Brown	ECU	On hold
Sustainable last km food and beverage delivery system - food and beverages	DPLH	Sae Chi	PATREC	Agreement executed. Project commenced

2.3. External projects progressed

Significant progress was made on external projects which are those which do not received any core funding (Table 2). The 3-year, $450k Australian Transport Research Cloud project was completed with AURIN and a new national initiative commenced as part of the National Critical Research Infrastructure Strategy (NCRIS), proposing an AURIN WA Node to support climate action in transport and land use planning research in WA.

Table 2: Summary of progress with external projects

External Project	Progress as at 31 December 2023
AURIN – national transport domain specialist (NCRIS funded) ($98k)	Completed
Australian Transport Research Cloud (Lead: Sharon Biermann; Data Commons, AURIN, UWA, Curtin) (450k, 3 years, end June 23)	Completed
AI-assisted Model Calibration for Real-time Traffic Simulation (iMOVE, Main Roads, Aimsun, UWA) ($400k)	90% complete. Due for completion by 30 March 2024
Optimising video analytics for traffic data collection and calibration incorporating fixed camera videos (Chao Sun; MRWA, iM, $200k)	40% complete. Due for completion: 29 November 2024
Application of Biochar Waste in Pavement Design ($200) (Lead Yuxia Hu; MRWA, iMOVE, UWA)	30% complete
Freight route priority trial evaluation ($140k) (Lead Tele Tan; MRWA, iMOVE, Curtin)	Telstra contracting issues resolved. Research expected to commence mid-March 24
Improved Roundabout Modelling using Drone Video analytics (Lead: Chao Sun; iMOVE, MRWA, UWA, Aimsun) ($392k)	90% complete. Due for completion 30 March 2024
Innovation Connection (Metrocount) – Video analytics application (Lead: Chao Sun) ($100k)	Completed
ARC Linkage Infrastructure, Equipment and Facilities 2024 round 1 (LIEF24): National Cycling Data and Analysis Platform (NCDAP) (Lead: UNSW, Sharon Biermann UWA lead; Curtin separately)	Successful. Contracting underway
ARC Industrial Transformation Training Centre for Automated Vehicles in Rural and Remote Regions (Doina Olaru, Sae Chi, Thomas Braunl, Paul Roberts involved from UWA - $5 million, led by QUT)	Successful. Contracting underway
National Critical Research Infrastructure Strategy (NCRIS), AURIN WA Node to support climate action in transport and land use planning research (Lead: Uni Melbourne; 4 yr, $620k; needs WA leverage)	Leverage from WA State Gov included in State budget - outcome due May 24
RAC Air Quality Monitor independent review 2 (Lead: Gavin Pereira, Curtin; $13k)	Quote accepted

2.4. Climate action program progressed

The roll-out of the new program of research: Climate Action in Transport and Land use Planning progressed well including the establishment and operation of the Climate Action Research Advisory Committee (CARAC), with Steve Beyer as the Chair and Susie Page as Deputy, three foundation projects contracted and progressed with a small biodiesel trial evaluation project proposed (Table 3) and a PATREC Climate Action program leader appointed at Curtin, progressing the development of a 3-year, CA strategic plan.

Table 3: Summary of progress with climate action foundation projects

Climate action project	Summary of progress as at 9 November 2023
Feasibility of battery-electric buses for regional school bus services (iMOVE, UWA ($230k; Electrical Engineering, DoT, PTA)	• Stakeholder interviews • School bus operator survey • School bus operator information session • List of all school bus routes with calculated energy and power requirements • Preliminary version of e-bus planning tool • Extended scope to include school-owned buses in some of the case studies
Accounting for carbon in the planning for new residential suburbs ($150k; iMOVE, UWA (AUDRC), DoT, DPLH)	• Case study precincts identified (with DPLH), data collection commenced • Transport modelling commenced by DOT • Identification of built form typologies in case study precincts in progress • GHG inventory scope for urban emissions defined • Methodology for emissions calculations established • Access to key Life Cycle Impact Assessment databases secured • Main concern is reliance on data collection from utility agencies and local government for case study precincts - slow
Mapping the Circular Economy of WA: Monitoring the contributions of circularity towards achieving Net Zero – Stage 1 ($300k; iMOVE, Curtin, DoT)	• Services agreement with Curtin executed • Kick-off meeting held on Monday 31 July 2023 • SC meeting held on 16 Aug 2023; next on 27 Nov 2023 • Commenced review of international literature and WA policies and relevant initiatives, commitments, indicators and targets • Significantly progressed data stocktake to assess the feasibility of the approach in relation to currently available data, as well as to identify potential challenges and limitations that need to be addressed
Evaluation of Hydrotreated vegetable oil (HVO) renewable diesel trial ($40k; Curtin (Engineering), DoT, Metronet)	• Under development

3. KNOWLEDGE TRANSFER

3.1. Research outputs

The focus of PATREC's research outputs in 2023 was on the publication of technical reports for completed projects – two overview reports were produced with more detailed technical reports concerning components of the research, appended (Table 4).

Five peer-reviewed journal papers were published in 2023 (Table 3) with ten journal papers progressed (submitted, re-submitted or accepted for publication) (Table 5). Thirteen seminar/webinar/conference presentations were given by PATREC associates at PATREC and other industry-organised events with specifically, eleven Australasian Transport research Forum conference papers presented (Table 6). Nine news articles on PATREC-research were published on the iMOVE website with links provided from the PATREC website (Table 4).

Table 4: Research publication outputs in 2023

Publication Title	Authors	Date
RESEARCH PROJECT TECHNICAL REPORTS COMPLETED		
Identifying opportunities to address transport disadvantage in Perth: Project Overview, including: • Annexure A: Literature review • Annexure B: TD risk score methodology • Annexure C: Transport equity methodology details • Annexure D: Table of results and guide • Annexure E: Maps and tables per population group	Sae Chi, Sharon Biermann and Tristan Reed	Dec 2023
Integrated IoT, computer vision and machine learning technologies for smarter bridge health monitoring and prediction: Project Overview, including: • Appendix A: Prototype models for vision-based displacement measurement & IoT sensor data communication and visualization (Milestones 3a-b) • Appendix B: Prototype Machine Learning models for predicting bridge displacement and vibration (Milestone 3c)	Zhen Peng, Jun Li, Wensu Chen, Robert Lee, Atif Mansoor, Sergio Banchero, Chao Sun & Sharon Biermann	Sept 2023
PEER-REVIEWED JOURNAL PAPERS PUBLISHED		
Vo, L. H., Martinus, K and Smith B (2023) A Demand Systems Approach to Understanding Medium-Term Post-Pandemic Consumption Trends, *Economic Papers*, 42, 2, 183-199.		
Owaidah, A., Olaru, D., Bennamoun, M., Sohel, F., Khan, N. (2023) Transport of pilgrims during Hajj: Evidence from a discrete event simulation study, *PLOS ONE*, 18(6): e0286460, https://doi.org/10.1371/journal.pone.0286460.		
Veen, A., Goods, C., Barratt, T. and Smith B. (2023) Power resources for disempowered workers? Re-conceptualizing the power and potential of consumers in app-based food delivery, *Industrial Relations: A Journal of Economy and Society*.		

Sun, Y., Olaru, D., Bright, C., McCarney, G., Sabri, S., Reed, T. W., Chen, Y., Amirebrahimi, S., Biermann, S., & Rajabifard, A. (2023). Making accessibility accessible: A flexible planning tool for enhanced urban analytics. *Research in Transportation Business & Management.*
Schepis, D., Purchase, S., Olaru, D., Smith, B., Ellis, N. (2023) "How Governments Influence Autonomous Vehicle (AV) Innovation", *Transportation Research A*, 178, https://doi.org/10.1016/j.tra.2023.103874.
PATREC PERSPECTIVES, BULLETINS, ARTICLES, VIDEOS PUBLISHED
https://imoveaustralia.com/project/accounting-for-carbon-in-planning-residential-neighbourhoods/
https://imoveaustralia.com/project/electric-school-buses-western-australia-feasibility-study/
https://imoveaustralia.com/project/supporting-the-future-road-freight-task-in-north-west-wa/
https://imoveaustralia.com/project/project-outcomes/perth-smart-transport-technology-roadmap/
https://imoveaustralia.com/project/mapping-wa-circular-economy-stage-1-achieving-net-zero/
https://imoveaustralia.com/project/micromobility-and-freight-exploring-opportunities-in-wa/
https://imoveaustralia.com/project/tour-based-mode-choice-model-development/
ATRF conference media statement https://www.uwa.edu.au/news/article/2023/november/conference-to-focus-on-climate-action-in-transport
https://imoveaustralia.com/education/phd-student-profile/anna-gannett/

Table 5: Journal papers in-progress in 2023 (Submitted, Re-submitted, Under Review or Accepted for Publication)

Journal Papers in progress
Banchero, S., Sun, Y., Stemler, T. Multi-objective graph partitioning for the MFD-based perimeter control of an urban network, *IEEE Access*. **Resubmitted**
Cummins, L., Sun, Y., & Reynolds, M. Intelligent Pick-up and Drop-off System for Passenger Vehicles. *Journal of Urban Technology*. **Under revision**
Sun, Y., Cummins, L., Ji, Y. & Pritchard, N. Modelling. Uncertainties for Automated and Connected Vehicles in Mixed Traffic, *Journal of Advanced Transportation*. **Under revision**
Knight, C., Olaru, D., Lee, J., & Parker, S. K. Hybrid work design profiles: antecedents and wellbeing outcomes. Resubmitted to *Journal of Vocational Behaviour*. **Under review**
Vazquez Melendez E. Bergey P. and Smith B. Blockchain technology for supply chain provenance: Increasing supply chain efficiency and consumer trust. *Supply Chain Management: An International Journal*. **Under review**
Mazzer, S., Xiao, T., & Chi, S. Exploring the spatial-temporal influence of the COVID-19 pandemic on road crashes in Greater Perth. *Sustainability*. **Under review**
Wang J., Smith B. and Lou, M. An Availability Design to Capture Heterogeneous Decision Rules: a Case Study for Airfare Choice *Transportation*. **Under review**
Curtis, C., Olaru, D., Smith, B., Reed, T. W., Knight, C., Biermann, S. Sustainable urban mobility transition through working from home. *Travel Behaviour and Society*. **Under review**
Hooper, P, Edwards, N & Bolleter, J. Do fears become reality? Evaluating community experiences before and after a higher density infill development. *Journal of Housing and the Built Environment*. **Under review**
Ting, S, Lymburn, T, Stemler, T, Sun, Y & Small, M (2024). Parameter Estimation for Gipps' Car Following Model in a Bayesian Framework, *Physica A: Statistical Mechanics and its Applications*. **Accepted for publication**

Table 6: Seminar, online webinar and conference presentations

SEMINAR/WEBINAR/CONFERENCE PRESENTATIONS
Presented at Australasian Transport Research Forum 2023, 29 November – 1 December
Zhen Peng, Jun Li, Wensu Chen, Raquib Hossain, Steve Atkinson (2023), Computer vision-based in-situ bridge displacement measurement
Robert Lee & Atif Mansoor Development of IoT based Bridge Health Monitoring System: A Work in Progress
Sergio Banchero, Yuchao Sun, Daniel Demiris, James Pearse, Craig Wooldridge (2023), Changing priority: the before-after evaluation of an active transport project using Video Analytics
Anna Taleb-Bendiab, Sergio Banchero, Yuchao Sun, Daniel Gilmore, Tim French, Lyndon While, Yuxia Hu, Mark Reynolds, Qindong Li, Lalinda Karunaratne (2023), Multi-objective optimisation for simultaneous scheduling of multiple roadwork programs
Verma, P., Olaru, D (2023) Identifying, measuring and minimising the hazards of frequent business air travel
Reed, T., Olaru, D., Sun, C., Biermann, S. (2023) Adapting ADAPT: a service-based accessibility toolkit
Tang, X., Smith, B., Olaru, D. (2023) Consumers' behavioural intention to adopt AV technology: China and Australia studies
Kiffin-Petersen, S., Purchase, S., Smith, B., Olaru, D. (2023) Prototyping trust in autonomous vehicles (AV)

Gannett, A., Hooper, P., Saunders, J., Trapp, G. (2023) A review of the international scientific literature on active school transport interventions. **Presented and published in proceedings**
Mazzer, S., Xiao, T., & Chi, S. (2023). Exploring the spatial-temporal influence of the COVID-19 pandemic on road crashes in Greater Perth. **Presented and published in proceedings**
Chi, S., Mazzer, S., & Xiao, T. (2023). Options assessment of smart transport technology options for Perth. **Presented and published in proceedings**
Other presentations (conference and other events)
TREK2School Project Overview presentations: • Cancer Council Western Australia, October 2023 • Walkability across Perth subregions, Telethon Kids Institute Bike to Work Event, October 2023 • Western Australian Bike Riding Reference Group Meeting, March 2023 • BEACHES Project Partner Meeting, March 2023
Gannett, A., Hooper, P., Saunders, J., Trapp, G. (2023) Inequitable Distribution of Walkability Surrounding Schools in Perth, Western Australia, *Livable Cities Conference*, 14-16 June, New York, USA.
Knight, C., Olaru, D., Lee, J., & Parker, S. K. (2023) Hybrid work design profiles: antecedents and wellbeing outcomes. *European Association of Work & Organizational Psychology* (EAWOP) conference, Katowice, Poland, May 24-27th
Kiffin-Petersen, S., Purchase, S., Olaru, D., and Smith, B. (2023) Comparing general trust to organizational trust: New insights from a prototype analysis. Trust Within and Between Organizations - *FINT Workshop 2023*, Helsinki, Finland
Sun, C. (2023) AITPM: Harnessing Video Analytics for Traffic Insights, In-person technical event: Thursday 20 July, Main Roads WA, Don Aitken Centre, Waterloo Crescent, East Perth
Smith, B., Reed, T., Biermann, S., Olaru, D. (2023) 'Decarbonisation of the Transport Sector and Economic Benefits: Impact of Working-from-Home COVID Experience', *European Transport Conference*, 6-8 September, Milan, Italy
Knight, C., Olaru, D., Lee, J., & Parker, S. K. (2023) Hybrid work design profiles: antecedents and wellbeing outcomes. *Australian and New Zealand Academy of Management (ANZAM) 36th Conference*, Wellington, NZ, 5-7 December
Bridge health project dissemination seminar presentations (30 August 2023): • Zhen Peng & Jun Li - Prototype models for vision-based displacement measurement • Atif Masoor - IoT sensor data communication and visualization • Chao Sun - Prototype Machine Learning models for predicting bridge displacement and vibration
Biermann, S (2023) iMOVE Working from Home Collaboration Forum #7. Online wrap-up presentation by Sharon Biermann - 7 March
Circular Economy presentations at events • Hopkins, J & Minunno, R (2023) Mapping the Circular Economy of WA: Monitoring the contributions of circularity towards achieving Net Zero *Circular Economy Western Australia (CEWA)*, 16 November • Hopkins, J & Minunno, R (2023) Mapping the Circular Economy of WA: Monitoring the contributions of circularity towards achieving Net Zero. *The Hub on SX*, 23 November

3.2. PATREC connection opportunities and events

PATREC arranged five events in 2023:

- the most significant being the organization of the 2023 Australasian Transport Research Forum (ATRF) conference, held in Perth from 29 November to 1 December
- John Taplin Memorial Lecture, 29 March
- Bridge Health project dissemination seminar, 30 August
- Mapping the Circular Economy of WA: Project milestone achievements showcased at 2 events, with more than 120 participants at Curtin's Living Legacy Lab:
    - Circular Economy Western Australia (CEWA), 16 November
    - The Hub on SX, 23 November

PATREC organised the ATRF 2023 conference at the University Club of Western Australia, with significant support from the local organising committee, comprising PATREC partners:

- Prof Sharon Biermann - Chair of the ATRF 2023 LOC; Director of PATREC
- Dr Sae Chi - Research Fellow at PATREC
- Charise Baker - Senior Administrative Officer at PATREC
- Steve Beyer - Director of Portfolio Strategic Projects Office at the Department of Transport (DoT) (WA); Chair of the CARAC
- Dr Ryan Falconer - Director of Future Mobility at the Department of Transport (DoT) (WA)
- Steve Atkinson - Principal Analyst Strategic Planning at Main Roads Western Australia (MRWA); Chair of PATREC Research Advisory Committee (PRAC)
- Adri van der Mescht - Research Director at Ipsos
- Jason Gordon - Planning Manager at the Department of Planning, Lands and Heritage (DPLH)
- Duncan Ellis - Network & System Planner at Public Transport Authority of Western Australia (PTA)
- Dr Courtney Babb - Senior Lecturer in the School of Design and the Built Environment at Curtin University
- Dr Katrina O'Mara - Senior Lecturer in Environmental Management and Sustainability in the School of Science at Edith Cowan University (ECU)

Program highlights:

- Special conference theme: climate action in transport
- 4 keynote presentations
- A record 138 papers presented across 35 concurrent sessions (5 parallel sessions), each with 3-4 presentations
- 3 site visits
- Welcome reception on 29 November 2023
- Conference dinner on 30 November 2023
- Lunch style closing ceremony on 1 December 2023

Delegate number and composition

- 217 registrations (128X full, 3-day, paid; 44X student, 3-day, paid; 9X 1-day, paid; 36 complimentary, sponsorship)
- Representing Academia (48%), Government (25% - record), Consulting (17%), Industry (10%)
- From WA (42%), NSW (21%), VIC (15%), QLD (13%), SA (4%), ACT (4%), NZ/other (1%)

Keynote speakers:

- Peter Woronzow, Director General – Department of Transport: Transport Portfolio Non-build outcomes
- Dr Alan Finkel AC, Chair of Stile Education and corporate adviser on climate change technologies. Australia's Chief Scientist from 2016 to 2020: The future of transport in a decarbonised world
- Professor Glenn Lyons, Mott MacDonald Professor of Future Mobility at the University of West of England, Bristol, UK: We all need to be climate activists now
- Professor Julie Lee, Director of the Centre for Human and Cultural Values, and Professor in Marketing in UWA Business School: Who is comfortable with their head in an oven and their feet in a bucket of ice?

Site visits

- Bicycle tour of the streets surrounding UWA, to hear from representatives of WA Department of Transport about current practice and design interventions for cycling in Western Australia
- RNOC tour included a presentation and tour of the Road Network Operations Centre (RNOC), a purpose-built, world-class facility designed to help manage congestion, optimise road network safety and performance
- Electric bus tour included a presentation on 'Transperth's EV bus experience to date', followed by an electric bus tour to Perth CBD.

Sponsorships ($61,500):

- Gold: Transport Portfolio (WA); IPSOS (in-kind)
- Silver: Western Australian Planning Commission (WAPC); Bureau of Infrastructure and Transport Research Economics (BITRE); Mott Macdonald
- Bronze: MetroCount; Department of Transport and Main Roads (QLD); Austroads; WSP; AECOM
- Conference dinner sponsor: SIDRA SOLUTIONS
- City partner: Business Events Perth
- Welcome reception sponsor: WA Centre for Road Safety Research (WACRSR)

The John Taplin Memorial Lecture was held on 29 March with the invited speaker being Professor David A Hensher, Professor of Management and Founding Director of the Institute of Transport and Logistics Studies (ITLS), University of Sydney Business School: Towards net zero sustainable transport: Current issues and solutions.

The Bridge Health project dissemination seminar was held on 30 August, with presentations by three key researchers on the main components of the study:

- Zhen Peng & Jun Li - Prototype models for vision-based displacement measurement
- Atif Masoor - IoT sensor data communication and visualization
- Chao Sun - Prototype Machine Learning models for predicting bridge displacement and vibration

Mapping the Circular Economy of WA: Monitoring the contributions of circularity towards achieving Net Zero – Stage 1, Project milestone achievements showcased at 2 events, with more than 120 participants, at Curtin's Living Legacy Lab:

- Circular Economy Western Australia (CEWA), 16 November
- The Hub on SX, 23 November

3.3. Teaching and training

- PhD student supervision: PATREC co-supervised 4 PhD students (Chao Sun, Sharon Biermann):
  - Graduated: Xiaolin Tang (PhD) co-supervised with Brett Smith from Business School. Title: Riding into the Future: People's Willingness to Rideshare in Autonomous Vehicles.
  - In progress (Chao Sun co-supervised):
    - Samson Ting (PhD) co-supervised with Thomas Stemler - data-driven approach to improve intersection modelling (PATREC and iMOVE top-up scholarships)
    - Liam Cummins (PhD) co-supervised with Mark Reynolds - smart pick-up and drop off solution
  - Xiaoyu Lin (PhD) co-supervised with Yuxia Hu from Civil engineering - recycled soft plastics in pavement

3.4. Research impact

3.4.1. Research project feedback

For completed projects, steering committee chairs/representatives are asked to provide feedback on the output quality and value for policy formulation. A new close-out report template to capture this feedback, for completion by steering committee leads, was tested in the case of the completed project: Identifying opportunities to address transport disadvantage in Perth. An extract of key points follows:

- The final overall report with annexures was "of high standard, clear interpretation, and contextualisation of findings" and "Recommendations were targeted and well-grounded"
- "TD risk score in Excel format was very useful, allowing sorting and filtering of SA2/data enquiries"
- "The TD score is an important step in identifying locations and at-risk populations in Greater Perth. Further work could inform development of more equitable transport policy, greater public transport optimisation, increased uptake of active transport and improve access to essential services"
- "The use of the TD score to build narrative around strategic decision making is the key application of this work. DoT's Cycling Team and Driver Access and Equity Team are planning to apply outputs in their work, guiding investment across Greater Perth and underpinning project planning"
- "Other ways the work may be applied by DoT or Steering Committee agencies include: guiding site selection for community facilities, informing affordable housing policy, prioritising early intervention strategies for at-risk population groups, improved first and last mile options that expand the reach of public transport, reducing the need to travel by encouraging and facilitating the use of online medical / social services and at-home visits, especially for low-income households, the elderly, and people with a disability, guiding locations where shared government service infrastructure might better meet community needs in less accessible locations and using strategic insights to support implementation of the State Seniors Strategy, the Multicultural Policy Framework, the Reconciliation Action Plan, and the Disability Access and Inclusion Plan"

(The close-out report was completed by Leonie Gibbons, Senior Policy Officer, Urban Mobility, Department of Transport, on behalf of Claire Thompson, Steering Committee Chair, 22 February 2024).

In relation to the completed project: Integrated IoT, computer vision and machine learning technologies for smarter bridge health monitoring and prediction, the feedback from the Chair of the Steering Committee was: the “Bridge Health monitoring project has successfully demonstrated that the advanced algorithms and technologies can inexpensively help Road Authorities to monitor bridges and their performances. PATREC collaborating with UWA and Curtin Universities has immensely contributed to this research and enabled the project to be completed within budget and time. Future collaboration can further improve the research outcomes and solve bridge health monitoring problem incorporating further new algorithms and technologies” (Raquib Hossain, Engineer Bridge Loading, Structures Engineering, Main Roads WA, email dated 27 March 2024).

3.4.2. Awards

Director accepted the invitation to the **AURIN Scientific Advisory Committee** (SAC) with other members: Marie Truelove (CSIRO Data61), Prof Matt Duckham (RMIT, Director, Information in Society EIP), Prof Jonathan Corcoran (UQ, Director, QLD Centre for Population Research), Lisa Bush (Geoscience Australia, Head, NLI Branch), Prof Chris Pettit (UNSW, Director, City Futures Research Centre), Isabel Ceron (ASSA, Project Lead, Decadal Plan 2023-32), Sean Copley (ABS, Ass. Director, Geospatial Solutions), Ellie Torabi (DITRDCA, Director, Research and Evaluation).

3.4.3. Stakeholder satisfaction survey results

The satisfaction survey for 2023, was conducted in March 2024, circulated to 173 stakeholders directly involved in PATREC research during 2023, with a response rate of 20% (n=35). University partners comprised 31% of respondents (down from 43% in 2022), with 60% government respondents (up from 49%) and 9% “other” (up from 8%) (Figure 1a). A percentage satisfaction rate of 80% was achieved. This is down 5% on the 2022 score (Figure 1a). The difference from 2022 is largely due to a shift of around 40% of government responses from ‘strongly agree’ to ‘somewhat agree’ (Figure 1b).

Despite the downward trend, 2023 satisfaction levels retain ‘strongly agree’ as the largest category with 94% agreeing (strongly or somewhat) to satisfactory performance (Figure 2a). 51% of respondents ‘strongly agreed’ to overall satisfaction with PATREC’s performance, 43% ‘somewhat agreed’ and 6% (one government and one university respondent), disagreed. Highest satisfaction (strongly and somewhat agree) was in relation to questions value for money (Q5), usefulness (Q1), extending networks (Q8) and bridging the gap between research and policy (Q9) (Figure 2b). As in past surveys, lowest levels of ‘strongly agree’ relate to understanding each other’s needs and bridging the gap between research and policy. If both strongly and somewhat agree are included, good interaction between partners, scores the lowest (Figure 2b). More detailed results for each question are provided in Figure 3.

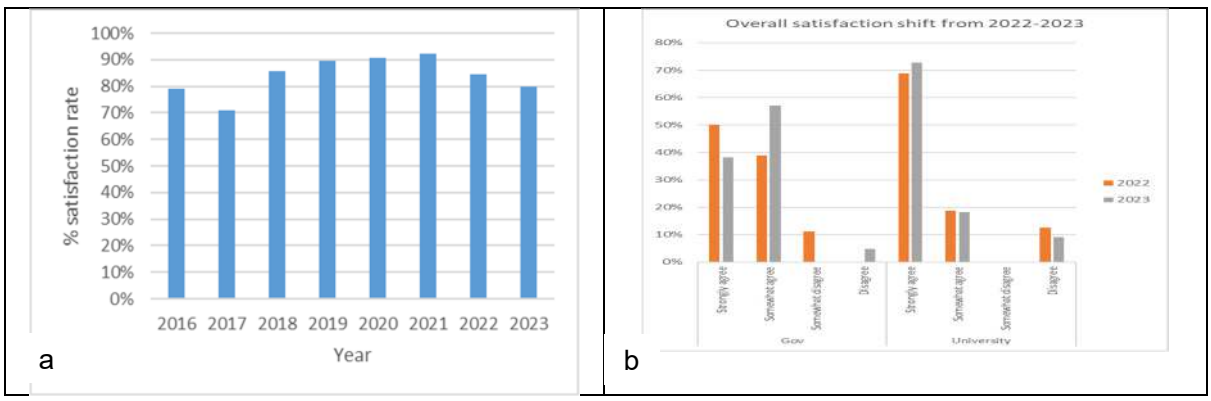


Figure 1: Trends in overall satisfaction with PATREC’s performance

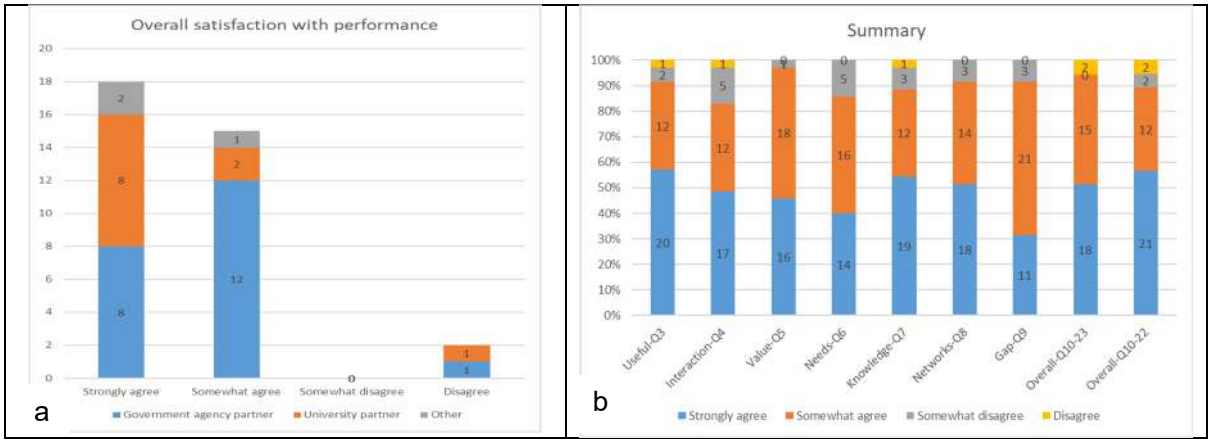


Figure 2: 2023 PATREC satisfaction survey response numbers and results (at March 2024)

Suggestions provided by respondents:

- It is advisable for government departments and institutions responsible for transport in our state to prioritise increased investment in R&D initiatives, particularly focusing on AV. HDR Scholarships and Chair positions would concentrate research efforts and increase performance (University).
- Streamline decision processes (University)
- Minimising admin through reporting, although this is mainly iMOVE (University)
- More awareness of the work that PATREC through either presentation at the agencies or through networking events (Government).
- PATREC needs to consider the Agencies requirements/outcomes for projects and not just focus on the statistical outcomes. In some instances this makes projects very costly (Government).
- Some staff need to appreciate the need for research conducted on behalf of Government to be more applied to the existing context. Also ensuring formal requests for data are made appropriately in a timely fashion will improve responses received. Research needs to be more integrated and the focus on a collection of outputs lessened (Government).
- Too early to tell if outcome (Government)
- Research takes too long to complete. The constant changes of students makes it difficult to meet schedules (Government).
- Building in flexibility, as practicable, to draw in additional resources - especially subject matter experts - to support delivery of complex projects. Sometimes, needs arise during delivery that weren't obvious at commencement (Government).
- Research is often presented without context and does not always accurately represent actual real world experience or critically interrogate outcomes (Government).
- Would be good to know more about research beyond what I am directly involved with and to get a better sense of the capabilities of researchers associated with PATREC. This could help in developing project ideas (new perspectives on research approaches can open possibilities for looking into challenges we face) (Government).
- Networking events (Government).
- Great to see more women on the PATREC Board :-) (Government).

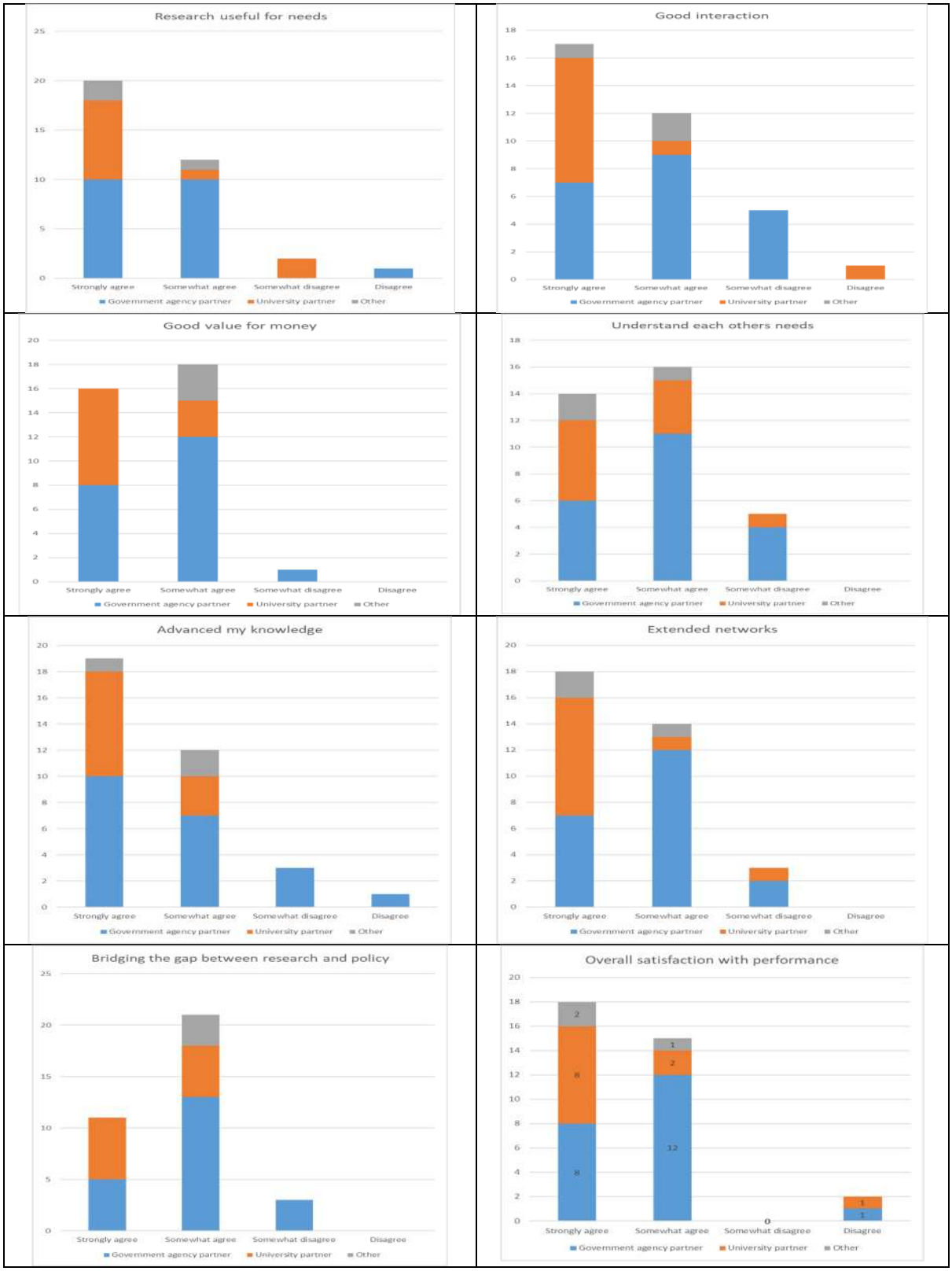


Figure 3: Individual question results

4. PEOPLE AND RESOURCES

4.1. Staffing

With leadership, administration and coordination by a small PATREC core team, a much wider team of PATREC project research associates from across partner universities and with some support from adjuncts, consultants and PhD students, were involved in conducting policy-informing, applied research in 2023.

The research team was broadly consistent with that presented in the Strategic Plan and Business Plan 2023 with extensions to expiring fixed-term and casual contracts taking place to ensure resourcing is secured to deliver on concluding and commencing core and external projects (Table 7). The new climate action program has broadened the range of expertise included in the PATREC team. Casual contract staff play a vital role in delivering on the research, usually in the role of research assistants.

In addition to the PATREC-funded core team, PATREC involves a number of academics who are employed full time by partner universities but who participate on an in-kind basis to conceptualise and manage projects, direct research assistants, undertake research and identify opportunities (Table 7). Limited use is also made of consultants where relevant expertise is not available within the partner universities.

Table 7: PATREC project researchers

Sharon Biermann	PATREC office - Director (0.4 FTE)
Charise Baker	PATREC office - Senior Administrative Officer (0.6 FTE)
Sharon Biermann	Research - Director – 0.6 FTE
Alessandro Sanches Pereira	PATREC Climate Action program leader (0.5 FTE), CUSP, Curtin
Yuchao Sun	PATREC Senior Research Fellow (traffic engineering); 1.0 FTE
Sae Chi	PATREC Research Fellow (transport economics); 1.0 FTE
Tristan Reed	PATREC Research Fellow (spatial analytics), Curtin (0.8 FTE)
Sergio Banchero	PATREC Research Assistant to Chao Sun (1.0 FTE)
Demiris Daniel	PATREC Research Assistant to Chao Sun (1.0 FTE)
Liam Cummins	PATREC Research Assistant to Chao Sun (0.4 FTE))
Tom Lymburn	PATREC Research Assistant to Chao Sun (1.0 FTE)
Max Davidson	PATREC Research Assistant to Chao Sun (1.0 FTE)
Samson Ting	PATREC/iMOVE PhD scholarship, research assistant (part time)
Padraig Lamont	PATREC Research Assistant (part time)
Lara Posel	PATREC Research Assistant (part time)
Erica Oertlinger	PATREC Research Assistant (part time)
Marcos Magalhaes	PATREC Research Assistant (part time)
Doina Olaru	Research Associate, UWA Business School
Kirsten Martinus	Research Associate, UWA Social Sciences
Brett Smith	Research Associate, UWA Business School
Richard Gruner	Research Associate, UWA Business School
Thomas Stemler	Research Associate, UWA Mathematics
Michael Small	Research Associate, UWA Mathematics and Statistics
Atif Mansoor	Research Associate, UWA Computer Science, Software Engineering
Robert Lee	Research Assistant, UWA Computer Science, Software Engineering
Mark Reynolds	Research Associate, UWA Physics, Mathematics, Computing
Farid Boussaid	Research Associate, UWA Electrical, Electronic, Computer Engineering

Mohammed Bennamoun	Research Associate, UWA Electrical, Electronic, Computer Engineering
Yuxia Hu	Research Associate, UWA Civil, Environmental and Mining Engineering
Colin Leek	Research Associate, UWA Civil, Environmental and Mining Engineering
Lynn Meuleners	Research Associate, WA Centre for Road Safety Research, UWA
Teresa Senserrick	Research Associate, WA Centre for Road Safety Research, UWA
Paul Roberts	Research Associate, WA Centre for Road Safety Research, UWA
Matthew Albrecht	Research Associate, WA Centre for Road Safety Research, UWA
Gina Trapp	Research Associate, Telethon Kids, UWA
Anna Gannett	Research Assistant and PhD candidate, Population and Global Health, UWA
Paula Hooper	Research Associate, AUDRC, UWA
Julian Bolleter	Research Associate, AUDRC, UWA
Bill Grace	Research Associate, Adjunct, AUDRC, UWA
Chris Lund	Research Associate, Adjunct, AUDRC, UWA
Thomas Braunl	Research Associate, Electrical, Electronic and Computer Engineering, UWA
David Harries	Adjunct Associate, Electrical, Electronic and Computer Engineering, UWA
Mark McHenry	Adjunct Research Associate, Murdoch University
Guido Wager	Research Associate, Electrical, Electronic and Computer Engineering UWA
Julie Saunders	Research Associate, Population and Global Health, UWA
Tele Tan	Research Associate, Electrical Engineering, Computing and Mathematical Sciences, Curtin
Jun Li	Research Associate, Civil and Mechanical Engineering, Curtin
Wensu Chen	Research Associate, Civil and Mechanical Engineering, Curtin
Zhen Peng	Research Assistant, Civil and Mechanical Engineering, Curtin
Ritu Gupta	Research Associate, Electrical Engineering, Computing and Mathematical Sciences, Curtin
Himanshu Agrawal	Research Associate, Electrical Engineering, Computing and Mathematical Sciences, Curtin
Carey Curtis	Research Associate, Adjunct, UWA, Curtin
Courtney Babb	Research Associate, Design and Built Environment, Curtin
Parisa Izadpanahi	Research Associate, Design and Built Environment, Curtin
Dora Marinova	Research Associate, CUSP, Curtin
Josh Hopkins	Research Associate, CUSP, Curtin
Roberto Minunno	Research Associate, CUSP, Curtin
David McMeekin	Research Associate, Electrical Engineering, Computing and Mathematical Sciences, Curtin
Yun Yu	Research Associate, Chemical Engineering, Curtin
Kerry Brown	Research Associate, Employment and Industry, Business and Law ECU
Flavio Macau	Research Associate, Employment and Industry, Business and Law ECU
Navjot Bhullar	Research Associate, Psychology, ECU
Kat O'Mara	Research Associate, Science, ECU
Ferry Jie	Research Associate, Supply Chain and Logistics Management, Business and Law, ECU
Hadrian Djajadikerta	Research Associate, Strategic Management Accounting, Business and Law, ECU
Zhaoyong Zhang	Research Associate, Finance and Economics, Business and Law, ECU
Mohammad Iranmanesh	Research Associate, Vice-Chancellor's Research Fellow, Business and Law, ECU

4.2. Finances

In 2023, the climate action income was captured and reported separately from that of the more "traditional" PATREC income. The year ended with a closing balance of $721k, $572k more than budget, mainly due additional climate action external funding and unbudgeted ATRF conference income received, as well as lower than expected expenditure (Table 8). The untimely and unexpected unavailability of the Climate Action program leader to work on the program for much of the year resulted in lower expenditure across both the PATREC office and research project line items, where 0.4 FTE and 0.6 FTE of his appointment, respectively, were budgeted.

Income ended at $2.5 million, $248k ahead of budget with expenditure $287k behind budget at $2.2 million.

Table 8: Financial summary for 2023

PATREC Income and Expenditure 2023	YTD Actual 31 Dec 2023	Budget 2023	Variance Budget vs YTD Actual
INCOME			
WA Government Grants (core subscriptions – trad.)	292,201	292,202	-1
Universities Sponsorship (core subscriptions – trad.)	210,803	210,803	0
iMOVE/external (traditional)	1,233,671	1,270,000	-36,329
Climate Action (WA gov core)	290,000	290,000	0
Climate Action (WA uni core)	72,500	72,500	0
Climate Action (iMOVE/external)	210,000	100,000	110,000
ATRF conference	173,846	0	173,846
Total Income	**2,483,021**	**2,235,504**	**247,517**
EXPENDITURE			
PATREC Office	**183,290**	**288,588**	**-105,299**
Research projects	**1,975,883**	**2,174,646**	**-198,762**
ATRF CONFERENCE	**17,474**	**0**	**17,474**
Total Expenditure	**2,176,647**	**2,463,234**	**-286,587**
YTD BALANCE	306,374	-227,730	534,104
Balance Brought Forward from 2022	**415,030**	**376,828**	**38,202**
CLOSING BALANCE (incl Balance B/F)	**721,405**	**149,098**	**572,306**

5. GOVERNANCE

5.1. Board members

The PATREC Board comprises a senior representative of each of the collaborating parties and a Chair who is independent of all Parties. Reece Waldock continued as the Independent Chair of the Board. Board membership in 2023 remained relatively stable with Prof Dora Marinova replacing Prof Nat Belcher as the Curtin representative and Prof Amanda Davies replacing Prof Andrew Page as the UWA member (Table 9). The PATREC Director is an ex officio member of the Board. The PRAC Chair and PTA are also invited to Board meetings.

Table 9: PATREC Board members 2023

2023
Adjunct Prof Reece Waldock AM, Independent Chair
Adjunct Prof David Caddy, Chair, Western Australian Planning Commission
Mr Peter Woronzow, Director General Transport, Western Australia
Mr Steve Beyer, Director, Portfolio Strategic Projects Office, Department of Transport
Prof Dora Marinova, Professor of Sustainability, Curtin University
Prof Kerry Brown, School of Business and Law, Edith Cowan University
Prof Amanda Davies, Head, School of Social Sciences, The University of Western Australia
Mr Ian Duncan, Executive Manager, Infrastructure, WALGA

5.2. Research Advisory Committees

In addition to the long-established PATREC Research Advisory Committee (PRAC), providing oversight to the more “traditional” program of PATREC research, a separate advisory committee was established to advise the Board on the Climate Action program (CARAC).

5.2.1. PATREC Research Advisory Committee (PRAC)

Comprising two senior representatives from each partner organisation, chaired by a nominated representative of one of the government partners, elected by the Board, the objectives of PRAC are to:

- maintain an element of formality and rigour to the research project identification, selection, support, monitoring and dissemination process;
- enhance communication amongst partners; and
- advise the Board on project level matters, allowing the Board to focus on strategic matters.

Steve Atkinson (Main Roads) continued as Chair and Ryan Falconer as Deputy Chair (Table 10). PRAC meetings were held three times a year, two weeks in advance of Board meetings.

Table 10: PATREC Research Advisory Committee (PRAC) members 2023

Name	Organisation
Steve Atkinson (Chair)	Main Roads WA
Mark Woods	Department of Transport
Ryan Falconer (Deputy Chair)	Department of Transport
Cory Ross	Main Roads WA
Damien Martin	Department of Planning, Land & Heritage
John Chortis	Department of Planning, Land & Heritage
Martin White	Public Transport Authority
Tele Tan	Curtin University
Courtney Babb	Curtin University
Ferry Jie	Edith Cowan University
Tony Marceddo	Edith Cowan University
Doina Olaru	The University of Western Australia
Brett Smith	The University of Western Australia
Negar Nili	WALGA

5.2.2. Climate Action Research Advisory Board (CARAC)

Established with the same objectives as the PRAC, CARAC also meeting three times a year in advance of PATREC Board meetings. Chaired by Steve Beyer from the Department of Transport, with Susie Page as the deputy chair, members are drawn from a wider field across government agencies, given the wider range of stakeholders involved in climate action, although the focus remains on transport and land use planning.

Table 11: Climate Action Research Advisory Committee (CARAC) members 2023

Member	Position/Organisation
Steve Beyer (Chair)	Director Portfolio Strategic Projects Office, Department of Transport
Susie Page (Deputy Chair)	Project Manager, Portfolio Strategic Projects Office, Department of Transport
Sam Wilkinson	Principal Policy Officer, State EV Strategy, Climate Change Division, Strategic Policy, Department of Water and Environmental Regulation
Helen McGettigan	Director – Planning and Strategy (Energy, Climate Change and Sustainability), Infrastructure WA
John Clifton	Manager Strategy and Innovation, DevelopmentWA
Qindong Li	A/Manager Network Management, Main Roads WA
Ryan Falconer	Director Future Mobility, Urban Mobility, Department of Transport
Melinda Payne	Director Design and Built Environment, Reform, Design and State Assessment, Department of Planning, Lands and Heritage
Dora Marinova	Professor of Sustainability, Curtin University Sustainability Policy Institute, Curtin University
Bill Grace	Adjunct Professor, Australian Urban Design Research Centre, UWA

5.3. Project steering committees

All PATREC core and most external projects are led by steering committees, comprising key researchers as well as government stakeholders and chaired by a government agency representative (Table 12). The iMOVE Programs Manager is automatically invited to each meeting. Steering committees have oversight on progress, provide access to information and data and review and accept key outputs. Steering committees are established in the process of project development and agreement execution and provide significant value in ensuring research is relevant to policy objectives and delivers impact.

Table 12: Project steering committee participation in 2023

Project title	Government	Research
Transport environment and kids… 15 years on	Chair: Michelle Prior, David Wake (DOT); Jason Gordon (DPLH); Sharnie Stuart (Education) Max Bushell (WALGA)	Gina Trapp, Anna Gannett (Telethon Kids, UWA)
Identifying opportunities to address transport disadvantage in Perth	Chair: Claire Thompson, Leonie Gibbons, Ryan Falconer, Warren Apter (DOT); Richard Struik, Christine Smart, George Cherian (Communities); Chris Cable (Health); John Chortis (DPLH); Louis Bettini (Main Roads); Gary Merritt, Duncan Ellis, Lom Piggott (PTA)	Sae Chi (PATREC); Tristan Reed (Curtin); Sharon Biermann
Integrated IoT, computer vision and machine learning technologies for smarter bridge health monitoring and prediction	Chair: Raquib Hossain, Steve Atkinson, Jewely Parvin (Main Roads); Sebastian Davies-Slate (WALGA)	Wensu Chen, Jun Li (Curtin); Atif Mansoor (UWA); Chao Sun (PATREC)
Machine learning models for road maintenance investment decision making	Chair: Qindong Li, Lalinda Karunaratne (Main Roads)	Chao Sun (PATREC)
Model for estimating delays at traffic signals	Chair: Graham Jacoby (Main Roads)	Chao Sun (PATREC)
Adequacy of the road freight transport network to support the freight task in Australia's North West now and into the future	Chair: Mark Woods (DOT); Flori Mihai (Main Roads); Mark Yee (DPLG)	Kerry Brown, Ferry Jie (ECU)
Enhanced vehicle detection at traffic signals and smart freeways	Chair: Cory Ross, Ziad Boufajreldin (Main Roads)	Farid Boussaid, Mohammed Bennemoun (UWA)
Evaluation of road safety treatments - road safety trial design and evaluation using video analytics	Chair: Adrian Bonner, Lucas Viljoen, Edward Rose, Steve Atkinson (Main Roads)	Chao Sun, Sergio Banchero, Paul Roberts, Matt Albrecht (UWA)
Impacts of e-rideables on the transport task in WA	Chair: Michelle Prior, David Wake, Liza Picton (DOT)	Doina Olaru, Brett Smith, Tristan Reed (UWA); Courtney Babb, Parisa Izadpanahi (Curtin)
Micromobility and freight – exploring opportunities in WA	Chair: Sarah Court, Claire Thompson, Chris Grame (DOT); Max Bushell (WALGA); Anita	Courtney Babb, S Zaung Nau, Hui Xie, Carey Curtis (Curtin)

	McCracken (RAC); Wayne Bradshaw (West Cycle)	
Transport mode choice development using PATHS data	Renlong Han, Sharif Siddique (DOT); Wes Soet (Main Roads)	Brett Smith, Doina Olaru, Tristan Reed (UWA)
Sustainable last km freight and parcel delivery system - retail and parcel delivery	Chair: Jason Gordon (DPLH); Markus Botte (Main Roads)	Sae Chi, Sharon Biermann (UWA)
Feasibility of battery-electric buses for regional school bus services	Chair: Steve Beyer, Ying Huang (DOT); John Bailly (PTA); David Edwards (Horizon Power); Sam Wilkinson (DWER); Sam Leong, Anthony Erickson (Western Power)	Thomas Braunl, David Harries, Guido Wager UWA); Mark McHenry (Murdoch)
Accounting for carbon in the planning for new residential suburbs	Chair: Steve Beyer, Callie Cummings, Ryan Falconer (DOT); Melina Payne (DPLH); Greg Ryan (DevWA)	Julian Bolleter, Bill Grace (AUDRC, UWA); Chris Lund (Murdoch)
Mapping the Circular Economy of WA: Monitoring the contributions of circularity towards achieving Net Zero – Stage 1	Chair: Steve Beyer, Susie Page (DOT); Cara Francis, Ariadne McLeod (DWER); Julie Brockman (City of Canning); Jesse McDonald (SWDC), Hayley Rolfe (GHD); Helen McGettigan (IWA)	Dora Marinova, Josh Hopkins, Roberto Minunno, (Curtin)
Improved Roundabout Modelling using Drone Video analytics	Chair: Scott Aitken (Aimsun); TK Kim (Main Roads),	Chao Sun
AI-assisted Model Calibration for Real-time Traffic Simulation	Chair: Scott Aitken, Mohammad Saifuzzaman (Aimsun); Rafael Carvajal, Raj Shah, Miaad Khayatian, Steve Atkinson (Main Roads)	Chao Sun
Optimising video analytics for traffic data collection and calibration incorporating fixed camera videos	Chair: TK Kim, Raj Shah, Miaad Khayatian, Steve Atkinson (Main Roads)	Chao Sun
Freight route priority trial evaluation	Chair: Cory Ross, Ziad Boufajreldin (Main Roads)	Tele Tan, Tristan Reed, Ritu Gupta
Application of Biochar Waste in Pavement Design	Chair: Chris Skantzos, Steve Atkinson (Main Roads)	Yuxia Hu, Colin Leek, Chao Sun (UWA)

6. PERFORMANCE AGAINST KPIs AND TARGETS

Broad key performance indicators set for PATREC relate directly to the value-add role or purpose for which PATREC was established. The university collaborators require an increase in research profile and performance while the government partners require better evidence on which to base policy and investment and development spending decisions. Performance indicators comprise essential academic and policy impact indicators with a focus on outputs and outcomes. Performance for the year against 2023 targets as set in the Annual Business Plan 2023, is summarised in Table 13. An academic ROI indicator and qualitative statement of impact have been included for the first time.

Table 13: Key performance indicator targets and achievements (2023)

Performance Indicator	Target 2023	Achieved as at 31 Dec 2023
Academic Performance Indicators		
Number of journal papers published	10	5
Number of peer-reviewed book chapters published	0	0
Number of peer-reviewed conference papers published in proceedings • ATRF Proceedings (Table 6)	6	3
Number of peer-reviewed books published	0	0

Number of post graduate research students attracted, retained and/or graduated (PATREC staff only):
• 1 PhD graduated Xiaolin Tang (Brett Smith, Sharon Biermann co-supervision)
• 3 PhDs retained (with Chao Sun co-supervising)
  • Samson Ting
  • Xiaoyu Lin
  • Liam Cummins
	8	4

Value ($) of research funding secured [all income except traditional core]	$1,817,500	$1,980,017
Academic ROI (5-year cumulative, project-based)	-	Overall: 2.7 (UWA: 2.9; Curtin: 2.4; ECU: 2.0)
Policy Impact Performance Indicators		
Number of high impact, policy-informing projects/sub-projects completed: • Bridge health, ATRC, AURIN domain, TD	7	4
Number of substantive Technical Reports/Working Papers accepted/published	7	4
Number of PATREC Perspectives/iMOVE news articles published	5	9
Number of presentations at PATREC and other connection events (including conference presentations not published) • 11 ATRF, 16 others	10	27
Number of connection events arranged and held ATRF conference; Bridge Health seminar; Circular Economy X2, John Taplin (Hensher)	3	5
Number of short courses, unit contributions presented	2	0
Project impact statements (qualitative)	-	2 (Extracts in 3.4.1)
Stakeholder (academic and policy) satisfaction indicator	90%	80%