

## Exploring opportunities for reducing education related aviation emissions: An Australian case study

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### ABSTRACT

#### CONTEXT

With increasing climate change concerns, there are calls for action to urgently peak and tail greenhouse gas emissions globally. The higher education sector is responsible for significant aviation emissions, including academic staff and students who undertake air-travel for teaching and learning. COVID-19 enabled a step-change increase in use of technological solutions due to the challenge of restricted movements, enabling rapid prototyping and widespread experiences of online interactions in-lieu of air-travel. With Griffith University's commitment to net zero emissions by 2029, academic staff have explored ways to reduce aviation emissions in the workplace.

#### PURPOSE OR GOAL

This paper presents the evaluation of the range of technological solutions within the university's policy context of reducing corporate aviation emissions, considering implications for engineering education. The authors aim to share the evidence-based enquiry into opportunities for aviation emissions reduction, to support accelerated progress in greenhouse gas emissions reduction programs within the Academic sector overseas and remote immersive collaboration for industry.

#### APPROACH OR METHODOLOGY/METHODS

The research involved extensive consultation with the Griffith University community concerning policy initiatives to reduce aviation emissions. A series of semi-structured interviews with ten key stakeholders and a week-long immersive digital discussion with 52 staff using the digital platform Recollective, were conducted. Thematic analysis (NVivo software) was undertaken on the data.

#### ACTUAL OR ANTICIPATED OUTCOMES

The aggregated results of the study were presented to the university, to inform policy development regarding aviation emissions for research, teaching and service activities. There are anticipated teaching and research practice developments at Griffith University that will encourage new teaching technologies, improved online delivery, virtual internship experiences and virtual global mobility.

#### CONCLUSIONS/RECOMMENDATIONS/SUMMARY

Given the complexity of the situation, there does not exist an off-the-shelf handbook of technical solutions. While Griffith University is looking to implement climate change policies and there are some initial university appraisals, there is a need for further investigation into existing and emergent teaching and learning solutions to ensure widespread adoption of effective tools. Emissions tracking tools for course work delivery should also be engaged with, to provide an evidence base for evaluating progress on commitments to greenhouse gas emissions reductions.

#### KEYWORDS

Technological solutions, aviation emissions, higher education sector

## Introduction

For universities, greenhouse gas emissions present a significant challenge to address in the campaign for net zero operations (Lee et al, 2021). Prior to the COVID-19 pandemic, around 12% of air travel was for business (Finances Online, 2020). As a result of COVID-19, emissions in 2020 declined significantly, including for business travel, and with events and conferences being cancelled or moved to online format. However there is a need to shift culture and processes for the longer term to manage and maintain ongoing emission reductions (Inmarsat, 2021).

The disruption associated with COVID-19 presented an opportunity to rethink approaches in engaging with content, and in enabling high-trust virtual environments for activities such as team-teaching, peer-to-peer learning, and experiential learning (Caldera et al, 2022). This 'virtual-in-person' approach is in addition to becoming used to the approach of embedding a 'blended learning' environment for augmenting physically-in-person sessions. Through recent active use of online meetings, events and conferences under COVID-19, staff efficiencies in 'dialing-in' online participants, or hosting sessions online or as a hybrid session have improved. However, the question of how to produce 'equivalent' experiences of 'feeling like you were really here' rather than (just) 'feeling like you were really there' remains challenging. Previously the first authors have documented this experience as enabling 'remote immersive collaboration', documenting the precedent and opportunities for such spaces (Desha et al, 2019, Desha and Caldera, 2019).

The authors of this paper asked, "*How can technology transform teaching and research practice, as well as address greenhouse gas emissions*". This was within a larger research question regarding how to reduce corporate aviation emissions. The study was prompted by Griffith University who were seeking to understand travel behaviour changes in the context of COVID-19 restricted movements, to explore opportunities for increasing the use of technological solutions for university activities. The wider research project generated an aviation emissions reduction plan for the university (Ryley et al., 2022) and an academic journal paper (Ryley et al., 2023). While there is an important role of motivation influencing academics' behaviour, this study specifically focuses on technological opportunities and their influence on aviation emissions. This paper presents findings from the exploration of technological solutions including remote immersive collaborations.

## Literature Review

Academics are hypermobile, conducting international air travel for conferences and networking, research and field trips, and disseminating and exchanging knowledge (Storme et al, 2013). Academics have an obligation to be present at these events and the associated travel can be a socially significant event (Storme et al, 2017). Storme et al (2017) argue that the meetings concept, originally developed by John Urry (see Urry, 2003), is an ongoing process with academics requiring both sparse and dense network meetings in their professional development. Sparse network meetings include large international conference events, whereas dense network meetings are much smaller and typically invitation-only. Storme et al (2017) also stress, like many others, the need to grow virtual rather than corporeal meetings for environmental and social reasons.

There is a growing need and increased expectation that universities will reduce their air travel and associated emissions from business air travel (Williams, 2019). Researcher credibility around large carbon footprints is starting to be questioned, especially those working in climate and environmental science (Attari et al., 2019; Whitmarsh et al, 2020). It has been acknowledged that academics have an underlying tension of being compelled and constrained when it comes to flying for business trips, considering time away and environmental impacts (Storme et al, 2013).

Technology-assisted learning, online learning, and blended and similar approaches have been discussed in previous literature. Key strengths of online teaching have been identified as a cost efficient method of delivery with an ability to leverage software, has capacity for individualise training and create opportunities for research activities and educational content. A range of weaknesses were uncovered including communication and classroom management problems, and issues with systems, software and infrastructure (Ameri et al., 2023). There have been efforts to

develop affordable remote immersive collaboration spaces for data access and engagement. One example is of Digital Earth Nodes (DENs), whereby researchers engage in real-time, pragmatic and rigorous enquiry through a global network of interconnected nodes. A DENs pilot study creating a research facility that enables university academics and practitioners from different disciplines, and who may be located anywhere around the world, to connect and collaborate without needing to travel and be face-to-face (Desha et al., 2019).

COVID-19 has helped to drive improvements in home-based working policies and improved digital tools for teaching, collaboration and virtual platforms for discussions and conferences. Many have reduced the need for business travel, have proved successful and are likely to continue post-pandemic. For example, the annual meeting of the European Geosciences Union had an increase of 10,000 delegates (Klower et al, 2020) when it became a virtual event. However, in locations such as Australia time zone constraints can impact the ability to engage in these online international conferences and partnerships (Glover et al, 2019).

Some innovative and viable solutions are emerging, such as having three conference reference hubs located exactly eight hours apart, for example in North or South America, Europe and the Asia-Pacific regions (Parncutt et al, 2021). A further justification of such solutions, which provide a wider global reach, and as outlined by Parncutt et al (2021), is around climate justice. Simply put, climate change typically affects poor countries more than rich countries, although rich countries produce more emissions and benefit from associated opportunities such as academic conferences. Centralised conference hubs or discouraging travellers from further away may generate further discrimination depending on the geography of participants and event locations. There would, therefore, need to be careful event planning to meet climate justice goals. Within this context, this study looks at technology-assisted learning in a new dimension.

## Methodology

This research was positioned with an interpretive paradigm, as this well-established research philosophy enables qualitative researchers to explore air travel emission reduction initiatives by engaging in in-depth conversation with participants to generate rich contextualised insights for the studied phenomena (Creswell, 2013). Consultation was undertaken with university staff, consisting of a series of semi-structured interviews and a week-long immersive digital discussion.

### Data collection - Interviews

The first stage of the data collection was to interview and consult Griffith University staff and key stakeholders. Initially, ten interviews were conducted in October and November 2020. Each lasted between 45 minutes and one hour. Participants were randomly selected, stratified by five groups: Griffith University travel staff (2), administrative staff (2), Griffith International (2), Institute Directors or Heads of School as senior managers (2) and senior researchers (2). The travel booking system administrators were the two principal individuals representing the Griffith university travel staff, one from Griffith University and one from the sub-contracted travel company CTM (Corporate Travel Management). For the remaining four groups, participants were randomly selected from the 2019 Griffith University travel database. Each interview consisted of open-ended questions split into two parts. The first part was a discussion of the background context on the role of the participant at Griffith University and their experience of air travel bookings and travel choices on university business. The second and main part of the interview was to explore air travel emission reduction initiatives that were split according to the four initiative categories.

### Data collection - Immersive digital discussion

The second stage of the data collection was to conduct a week-long immersive digital discussion with 52 Griffith University staff using the digital platform Recollective. Recollective (<https://recollective.com/>) is an immersive qualitative approach using a digital platform which enables the exploration of new ideas and policy options. Recollective has been used previously at Griffith University, and ten experienced moderators encouraged and prompted participants.

Participants were expected to commit around 15 minutes per day, joining in the discussion at a time of their own convenience during the day. Most participants committed more time. Data included a pre-screening survey, hypothetical air travel scenarios, testing of various options (according to the approaches), and self-generated discussion forums.

From invitations to 1,500 Griffith University staff (randomly selected from the 2019 dataset), as well as a university website banner advert, university email and research project request, 56 staff members agreed to take part in the week-long Recollective study (17<sup>th</sup>-23<sup>rd</sup> November 2020). 52 respondents started participation and 46 completed all five days; 632 test-based exerts were generated. A five-digit code name was assigned to each participant so that the aggregated data is de-identified. The sample is representative of Griffith University staff who took a flight in 2019, although there are a high proportion of female participants (67%), and one of the four academic Groups (Griffith Business School) had a low proportion of participants (9%). The Recollective study ran across five days. The first day provided a general introduction to university air travel and COVID-19 impacts. The remaining four days covered each of the four main policy initiative categories: 1) Travel policy, 2) Research and Teaching, 3) Planning and Procurement, and 4) Operations and IT. The initiative categories are shown in Table 1, together with the aligned ideas to test in the Recollective study. This paper will specifically focus on initiative categories 2,3 and 4.

**Table 1: Policy initiatives tested in the Recollective study**

Initiative Category	Ideas tested in Recollective
1. Travel policy	University travel policy & procedures; Aviation emissions response
2. Research & teaching practice	Blended teaching development; Online conference developments
3. University planning & procurement	Pre-trip approval decision tree; Emission dashboard; Enhanced carbon calculation; Flexible working arrangements
4. Operations & IT	New technologies (e.g. DENs); Performance indicators; Corporate rewards & awards

## Data analysis

The digitally recorded interviews (through MS Teams) were transcribed, and data reduction methods were then used to analyse the information (Miles and Huberman, 1994). Qualitative data from the recollective platform was exported into a desktop folder ensuring the anonymity of the participants. A thematic analysis method was applied to identify emerging themes in interview and Recollective data (Braun and Clarke, 2006). A combination of inductive and deductive reasoning approaches was employed (Braun and Clarke, 2006). The analysis began with a deductive or theory-driven coding system (A-priori codes based on the initial literature review and expert consultations) using NVivo 11 software, while creating additional new nodes (In-vivo codes), inductively from emerging interview data. Axial coding then categorised data in new ways, identifying associations and links between initial codes (Savin-Baden and Major, 2013). This analysis includes respondent quotes as anonymous participant 'P' numbers<sup>1</sup>.

## Findings and Discussion

### Findings - Interviews

Technological solutions in terms of transforming teaching and research practice were examined. All participants viewed leveraging digital technologies for research and teaching as a critical component for reducing aviation emissions and being resilient in the face of future disruptions. Blended approaches, virtual reality, simulation and virtual internships were key factors discussed under transforming teaching practices.

<sup>1</sup> Interview respondents were assigned a 'P' number from one to ten; Recollective respondents were assigned a random five-digit 'P' number.

Technology transforming teaching practice: Participants emphasised the importance of developing and promoting online courses and creating blended teaching programs considering the Covid-19 online transitions of coursework delivery. Furthermore, using virtual reality and simulations (i.e. virtual lab, virtual pharmacy) to enhance the classroom experiences were raised by several participants (P3, P5). “Virtual internships” (P4, P5) were suggested as an alternative for overseas exchange programs, to learn about global cultures and practices.

Technology transforming research practice: Transforming research practices using elements such as online platforms for communication and data transfer, online conferences, strategic research, and collaboration actions and streamlining academic studies programs were also suggested. Many of the participants (P5, P7, P9 & P10) proposed potentially leveraging immersive research collaborative platforms dedicated to quick data transfer and easy communication.

However, moving forward, participants were keen to have advanced capabilities such as easy, real-time data transfer. They also highlighted the potential use of open sources to share data and create more accessible, discipline specific tools. For example, “the open science framework is a good example of a place where you can upload data and share data and collaborate one data as well. I guess people are more using it. I think this is already happening” (P3). Moving forward, hybrid conferences were viewed as an alternative to enable remote participation. For example, “*I think that you are going to have to look at hybrid options in delivering those to ensure maximum participation, because you'll still have a price point*” (P4). While there was consensus among interview participants concerning the importance of being in the field, they emphasised the need for collaborating with host universities and local industry partners to assist with remote data collection (P10). It also means a travel conditions/assessment could be conducted as a part of research project plans to be submitted as a part of the risk assessments process.

## Findings - Immersive digital discussion

Most academic staff members acknowledged leveraging digital technologies for research and teaching as a key approach for reducing aviation emissions. Table 2 summarises a suite of the proposed research and teaching methods targeted towards reducing emissions.

It was also highlighted how the COVID-19 has enabled them to consider digital replacements for air travel. For example, “The pandemic has taught us that there is a need, systems, and people can adapt rapidly to evolve with the situation. If there is justification to change practice (for better results in cost savings and the environment), leadership in this space can change behaviour rapidly. Technology will grow to fill the gaps that may be needed to ensure that digital replacements for existing practices may call for” (P34200).

Transforming teaching practices were discussed under ‘*online teaching*’, ‘*using virtual reality*’, ‘*simulations*’, ‘*virtual internships*’ and ‘*transnational education alternatives*’. Several participants highlighted the criticality and urgency of developing online courses and creating blended teaching programs, learning from the Covid-19 online transition. It was also noted that online teaching is a cost-effective approach compared to delivering courses face-to-face considering the resources and travel time. For example, “*The only justification for large lectures is cost-effectiveness. We can probably teach cheaper and better online than we do face-to-face*” (P34189).

The focus of the work is on university staff, but clearly there are air travel links to international students. From an international student perspective (P34187), there were very significant concerns about online learning, both from a student visa compliance perspective<sup>2</sup> and from a student experience perspective. International students come to Australia to study (or to another country) are seeking an experience and a return on investment, part of which is engagement with academics and with their peers, including Australian students. The participants were yet to fully understand the global impact of COVID will be in terms of longer-term take up of online study for part or all of a degree, but they were not anticipating a full pivot.

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<sup>2</sup> There are normally limitations about the proportion of a student's program that can be undertaken online, and some sponsoring bodies don't allow any online study

**Table 2: Summary of proposed teaching and research methods**

Category	Method	Selected quotes
Teaching	Online teaching	<i>The university can (and presumably has) reduce a lot of unnecessary travel by encouraging online meetings with stakeholders elsewhere. In my experience, teaching has minimal travel needs and the conferences I'm interested in (online pedagogies) are usually organised well online. Research is the hard one - I wish I didn't have to travel so much but consider it a necessary downside of doing research. (P34207)</i>
	Simulations (virtual lab, virtual pharmacy)	<i>Additional online simulated learning experiences, such as telehealth, electronic case notes, team meeting etc, which are particularly related to health. They apply knowledge so that students can develop skills prior to being exposed to managing 'real' patients. Students can participate in these activities irrespective of their geographic location. These skills are contemporary. (P34212)</i>
	Electronic case notes	
	Team meetings, Collaborate Ultra, Zoom	<i>For content: classy, creative, contemporary platforms, that look awesome and are enjoyable to use (Blackboard is not really fun to design in or, I bet, as a student) (P34188)</i>
	Virtual reality/ augmented reality	<i>Immersive technology (Virtual/Augmented) will allow for experiences to occur without the need to travel. Virtual reality or Augmented reality applications can also reduce the need for large amounts of hardware (ie 1x headset vs 4x screens, touch table and two projectors + webcams) however the platforms, experiences and cleanliness considering COVID are all factors here too. (P34228)</i>
	Virtual internships/ placements	<i>In physio, we have been looking at international virtual placements and supporting rural placements. This could have a very interesting place there (P34241)</i>
Research	Online platforms for communication and data transfer	<i>The university can (and presumably has) reduce a lot of unnecessary travel by encouraging online meetings with stakeholders elsewhere. (P34207)</i>
	Online conferences	<i>Going forward hybrid conferences were viewed as an alternative to enable remote participation. For example, My experiences have been great! Before COVID19 conference fees were high, travel fees and time were an issue to many people. This year, many conferences with amazing speakers from around the world were available to all free of charge; there is so much to learn and to share! (P34092)</i> <i>to understand what measures are being provided to create an optimal virtual experience e.g. virtual break-out rooms etc., so that pressure is put on 'host' conferences to offer this as an option. (P34233)</i>
	Re-evaluating academic studies programs	<i>Look at the activities planned and determine whether travel/amount of travel is essential to meet ASP goals. Are there colleagues that reside closer to home that should be visited rather than those in Europe/USA? So look critically in the Asia Pacific region - this also meets the vision of the university. Look critically at the planned route being taken. Direct flights produce fewer carbon emissions than non-direct flights but might be more expensive. Also look at other forms of travel, e.g., trains and buses, when travelling between locations, instead of flying (P34212)</i>
	Software support and physical infrastructure	<i>For modelling, perhaps remote/virtual PCs. And more university laptops with all software including e.g. EndNote, or the possibility to install those on home computers. The shared drives and Teams do a pretty good job, I find. (P34209)</i>

Another interesting insight from by participants concerned *Transnational Education* (TNE). While the normal model for Griffith is to engage in TNE via partnerships and to fly staff in and out for intensive teaching. COVID-19 has had a big impact and will reduce existing TNE partnerships and activities significantly, and this will have a positive impact on carbon emissions as it will naturally reduce the number of staff flights to Singapore and China to teach. This was raised as a potential area for evaluation particularly using travel to Singapore and China for TNE purposes in 2019 as a baseline, it will be interesting to compare his with TNE travel once travel recommences. One participant pointed out that global mobility could take the form of virtual global mobility while considering carbon emissions during these overseas learning experiences. For example, *“In terms of global mobility (learning abroad) we have an opportunity to extend our offerings to include virtual global mobility, but we would hope in the longer term that this increases participation rather than replacing overseas experiences. Carbon offsetting may have to be an important component of student international travel”* (P34187).

Transforming research practices were considered using elements such as hybrid conferences, online meetings, collaborations to support remote data collections and non-travel related academic studies program options. Hybrid conferences were viewed as a positive alternative to enable remote participation. *“My experiences have been great! Before COVID19 conference fees were high, travel fees and time were an issue to many people. This year, many conferences with amazing speakers from around the world were available to all free of charge; there is so much to learn and*

to share!” (P34092). Participants emphasised that hybrid conferences open a window of opportunity for a wider range of people. For example, *“I love those other people who wouldn't normally be able to go to conferences or travel to events, like carers, people with disability, people from low-income countries, are able to access scholarly knowledge. The pandemic has been a boon in that regard”* (P34188).

While some participants were satisfied with the level of social interactions during online events, there was another group of participants who are frustrated by a lack of social engagement. For example, *“Conferences online is fine, and even preferable to me, because it avoids awkward small talk if you haven't yet developed meaningful connections”* (P34091). In addition, *“granted, you will never be able to fully replace the camaraderie of an in-person conference in an online environment, but I think the format offers an important alternative to costly and time-consuming in-person events”* (P34183). There was agreement among participants on remote data collection on the need for collaborating with host universities and local industry partners for assistance. However, some participants raised that it is essential for them to travel due to the type and the discipline of their study. For example, *“Some research it is necessary to travel. Like Archaeology, Clinical trials etc. So, putting extra burden on research to limit travel may not be in the university's best interest”* (P34219).

The Academic Studies Program (ASP)<sup>3</sup> was viewed as a critical opportunity to gather experiences in different institutions which helps to shape personalities, sharpen the way one approaches and solves problems in life and work. For example, *“being able to gather experiences in different institutions will always be of an advantage. Having moved between continents for work three times I personally think that the skills and experiences that one gains by visiting, working, and teaching at different institutions cannot be thought in lectures, as the overall experience shapes personalities, sharpens the way one approaches and solves problems in life and work”* (P34198). However, more emphasis was placed on the time taken during the period rather than the place. For example, *“The time itself is the precious element of ASP, not necessarily the ability to travel. If staff is encouraged to consider non-travel related ASP (writing a book, extended focus on local research, developing virtual partnerships, and the like), I don't see this as a big deal. Travel may be needed in certain circumstances, but I think strong environmental or justice outcomes would need to be argued”* (P34091).

Planning and procurement: Visualising emissions through a dashboard was highlighted as a potential tool to prompt behavioural change. For the dashboard to be effective and to be interpreted correctly by the end-users, several factors were highlighted as critical characteristics. These characteristics include having clear interactive updated maps; total emissions with relatable examples, aircraft, and cleaner fuel information (P34194, P34186, P34212). Equivalent examples, such as the one suggested by P34188 to present air travel emissions against other emissions by individuals (e.g. from surface travel or household energy), will enable the users to better relate the data presented in the emission dashboard. Integrating actual aircraft information and cleaner fuel options were also emphasized. *For example, “If this is supposed to be accurate information, it needs to populate with the actual aircraft (and airline, since flight profile makes a significant difference as well”* (P34189).

Operations and IT: Leveraging IT tools were acknowledged by all participants and particularly the importance of Digital Earth Node (DEN) was discussed in detail. The DEN technology is currently in the case study phase (located on the Griffith University Nathan Campus). It was identified as a potential pathway for improved deeper and immersive collaborative experiences which would allow researchers and academics to access data in real-time and interact with others in different locations. After viewing the video demonstration participants commented on this as a development with future potential to offer a deep, immersive and interactive experience to meeting attendees

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<sup>3</sup> This is Griffith University program for academic staff to take a ‘sabbatical’, time out from their teaching duties, typically to focus on research.

from different locations, particularly appropriate for sharing data and having remote collaborations. Table 3 presents a summary of perceived characteristics of DEN (with supporting quotes) that emerged through the participants' commentary.

**Table 3: Perceived characteristics of DEN**

Category	Supporting quotes (selected)
Remote access	<i>"I didn't really see the benefits of this as opposed to something like Zoom, except having multiple screens/docs open at once. I'm not sure what I was missing... It would have been good to see what it looks like with multiple people with remote access to simulate the international conference environment or teaching when students are off-campus. I don't know how this technology will change things more than current platforms"</i> (P34091)
Immersive and interactive the experience	<i>"This is fantastic The more immersive and interactive the experience, the greater the success for any global event wanting to go virtual. The immediacy offered by this format is a huge improvement on the individual screen formats available now"</i> (P34183)  <i>"A decision has already been made that we will not return to traditional large lectures on multiple campuses for reasons of finance but this can help achieve sustainability goals also by reducing cross-campus travel. This solution might be a better option for delivering lectures that allow students to feel like they are in the room and that provide a more real experience. I would suggest we need pods/rooms on campuses for the students as an option - we cannot assume students have an optimal home environment in which to join lectures etc."</i> (P34187)
Possible synchronous vs asynchronous delivery	<i>"I can imagine this being used now, as we face the possibility that some teaching which is normally required to be face to face, may have to be offered online in 2021 due to global travel restrictions, e.g. 1st year DMedicine students and 1st year Bachelor of Dental Health Science students based overseas may undertake their first year of study online, and this kind of technology would surely enrich that experience (although the challenge of time zones and synchronous vs asynchronous delivery will remain)"</i> (P34187)
Futuristic	<i>"They will give us a more 'real' option of collaboration. I think it's important that these technologies are easy to use. Also, a bit 'futuristic' maybe, but are there any opportunities within VR to do a remote collaboration?"</i> (P34194)
High- quality virtual meetings	<i>"Enabling better communication and interaction with colleagues in other cities and globally. best results if members have an existing relationship already; if new collaboration I believe that a face-to-face meeting first time is important, followed by DEN mediated communication. A good balance between f2f and online is critical. Sensitive meeting, e.g. involving negotiations are best f2f"</i> (P34221)  <i>"Makes quality virtual meetings possible that can accommodate multiple sites and individual users. My concern is that, prior to COVID, I don't believe I have attended a meeting that didn't have problems connecting between sites. Better technology is definitely needed, as well as awareness and understanding on the part of the user. Even Zoom meetings are limited by the poor quality of internet connections in Australia"</i> (P34232)

## Conclusions

COVID-19 has highlighted the capacity of academic staff to re-consider the need for travel (e.g. short haul travel for meetings). It is timely to harness the teaching and research practice innovations for sustained improvements in online delivery, virtual internship experiences and virtual global mobility. It is also timely to engage in the systematic collection of travel related data and monitoring of emissions. This will benefit the campaign for net zero operations and in some instances also result in more inclusive opportunities for staff. Carers, and staff members who would not usually travel to conferences and events now have more access potentially to scholarly knowledge through virtual conferences and research/teaching.

The larger research project recommended an improvement to data, clear measures which are then translated into performance indicators in group levels, supported by tools such as: a carbon calculator, emission impact dashboard, flight data management, and visualisation of information. Moving forward, an aviation emissions reduction plan for the ongoing delivery stage has been submitted to the Griffith University Environmental Sustainability Committee for review and implementation.

Considering teaching and learning and research activities there should be clear links between these measures and their contribution to the university's commitment to contributing to a robust, equitable and environmentally sustainable society. Future research could investigate the costs of a typical academic activity involving aviation emissions, immersive collaborative spaces and compare digital and physical experience.



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