## FOSTERING BOTTOM-UP COLLABORATIVE CONNECTIONS IN SCIENCE, TECHNOLOGY AND INNOVATION: THE CASE OF BRAZIL-AUSTRALIA COOPERATION

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The purpose of this paper is to analyze the development of the cooperation between Brazil and Australia in science, technology and innovation (ST&I), as a unique collaboration resulting from a bottom-up strategy. Different from the cooperation approaches with other countries, with whom historical and cultural relations exist, it was built upon people-to-people linkages. Substantial partnerships between universities were fundamental to those linkages, fostering exchange programs and collaborative projects. They contributed to consolidate a critical mass among researchers, a condition expected by both countries' governments to move forward signing an international high-level political agreement, which is currently implementing its first Joint Committee. The paper describes both countries' institutional architecture, policy documents, agreements and exchange data, providing inputs for an exploratory analysis of their agenda and policy objectives for ST&I cooperation. It also demonstrates how people-to-people linkages can be fruitful when established in areas of common interest, such as water resources management, agriculture and tropical diseases, leading to an inevitable thickening of the ST&I cooperation. This analysis confirms the success of a bottom-up approach to ST&I cooperation in the pursuit of joint solutions for common challenges. When political will meets a strong scientific knitting and bilateral technical awareness, forthcoming results are expected to enhance strategic projects in areas of emerging importance. The expectation is to help policy makers comprehend the value of already existing partnerships, therefore stimulating innovative projects under the Brazil-Australia ST&I Agreement.

**Keywords**: international cooperation; science, technology and innovation; science and technology policy; Brazil; Australia.

## PROMOVENDO CONEXÕES COLABORATIVAS *BOTTOM-UP* EM CIÊNCIA, TECNOLOGIA E INOVAÇÃO: O CASO DA COOPERAÇÃO BRASIL-AUSTRÁLIA

O objetivo deste artigo é analisar o desenvolvimento da cooperação entre o Brasil e a Austrália em ciência, tecnologia e inovação (CT&I), como uma colaboração singular resultante de uma estratégia *bottom-up* (de baixo para cima). Diferentemente das abordagens de cooperação com outros países, com os quais existem relações históricas e culturais, foi construída a partir de vínculos entre pessoas. Parcerias substanciais entre universidades brasileiras e australianas foram fundamentais para essas articulações, promovendo programas de intercâmbio e projetos colaborativos. Elas contribuíram para consolidar uma massa crítica entre pesquisadores, uma condição esperada pelos governos de ambos os países para avançar na assinatura de um acordo político internacional de

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alto nível, que atualmente está implementando seu primeiro Comitê Conjunto. O artigo descreve a arquitetura institucional, documentos de políticas, acordos e troca de dados de ambos os países, fornecendo insumos para uma análise exploratória de sua agenda e objetivos de políticas para cooperação em CT&I. Também demonstra como as conexões entre pessoas podem ser frutíferas quando estabelecidas em áreas de interesse comum, como gestão de recursos hídricos, agricultura e doenças tropicais, levando a um inevitável adensamento da cooperação em CT&I. Esta análise confirma o sucesso de uma abordagem *bottom-up* para cooperação em CT&I na busca de soluções conjuntas para desafios comuns. Quando a vontade política encontra uma forte malha científica e consciência técnica bilateral, espera-se que os próximos resultados aprimorem projetos estratégicos em áreas de importância emergente. A expectativa é ajudar os formuladores de políticas a compreender o valor das parcerias já existentes, estimulando, assim, projetos inovadores no âmbito do Acordo de CT&I Brasil-Austrália.

**Palavras-chave**: cooperação internacional; ciência, tecnologia e inovação; política científica e tecnológica; Brasil; Austrália.

## FOMENTANDO CONEXIONES COLABORATIVAS *BOTTOM-UP* EN CIENCIA, TECNOLOGÍA E INNOVACIÓN: EL CASO DE LA COOPERACIÓN BRASIL-AUSTRALIA

El objetivo de este artículo es analizar el desarrollo de la cooperación entre Brasil y Australia en ciencia, tecnología e innovación (CT&I), como una colaboración única resultante de una estrategia *bottom-up* (de abajo hacia arriba). A diferencia de los enfoques de cooperación con otros países, con los que existen relaciones históricas y culturales, fue construida a partir de vínculos entre personas. Las asociaciones sustanciales entre las universidades brasileñas y australianas fueron fundamentales para estas articulaciones, fomentando programas de intercambio y proyectos colaborativos. Contribuyeron a consolidar una masa crítica entre los investigadores, una condición esperada por los gobiernos de ambos países para avanzar en la firma de un acuerdo político internacional de alto nivel, que actualmente se encuentra implementando su primer Comité Conjunto. El artículo describe la arquitectura institucional, los documentos de política, los acuerdos y el intercambio de datos de ambos países, proporcionando insumos para un análisis exploratorio de su agenda y los objetivos de política para la cooperación en CT&I. También demuestra cómo se pueden establecer conexiones fructíferas entre personas en áreas de interés común, como gestión de los recursos hídricos, agricultura y enfermedades tropicales, lo que conduce a una inevitable profundización de la cooperación en CT&I. Este análisis confirma el éxito de un enfoque *bottom-up* para la cooperación CT&I en la búsqueda de soluciones conjuntas a desafíos comunes. Cuando la voluntad política se encuentra con una red científica fuerte y una conciencia técnica bilateral, se espera que los próximos resultados mejoren los proyectos estratégicos en áreas de importancia emergente. La expectativa es ayudar a los formuladores de políticas a comprender el valor de las asociaciones existentes, estimulando así proyectos inovadores en el marco del Acuerdo de CT&I Brasil-Australia.

**Palabras clave**: cooperación internacional; ciencia, tecnología e innovación; política científica y tecnológica; Brasil; Australia.

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## 1 INTRODUCTION

Brazil and Australia have a lot in common, from the enormous landmasses to the environmental challenges and multicultural societies, being the two biggest countries of the Southern hemisphere and among the six biggest in the world. Both countries play a central role worldwide in the production of energy, as agricultural exporters, in water and biodiversity conservation, in the development of financial technologies, as well as in public health and tropical medicine (Brasil, 2021b). Additionally, both the countries are part of international environmental agreements, such as Climate Change, Climate Change-Kyoto Protocol, Climate Change-Paris Agreement (CIA, 2022). Altogether, Brazilian and Australian researchers have gradually drawn attention to each other, recognizing similarities and complementarities in science, technology and innovation (ST&I), followed by the strengthening of trade and investment ties.

This bottom-up approach to ST&I cooperation differs from other countries' cases with whom Brazil has a long historical and cultural relationship, such as France, Germany and the United States.[3] It is also distinct to some top-down approaches, as are the cases of Japan, China and South Korea[4] (Brasil, s.d.; Fujita, Kwon and Fink, 2013). In the case of Australia, diplomatic relations were initially established in 1945, inaugurating new opportunities for Brazilian researchers to connect and learn about the other country particular features and strengths.

Since then both countries have a track record of cooperation and convergence in themes of common interest on multilateral forums, such as the United Nations (UN) forums, the Group of Twenty (G20) Summit Meetings and the World Trade Organization (WTO). However, it was just in the first two decades of the 21st century that both countries boosted bilateral cooperation in ST&I. A first Memorandum of Understanding (MoU) was signed in 2001 between the Brazilian Ministry of Science, Technology and Innovation (MCTI) and the Australian Department of Industry, with cooperation priorities oriented towards biotechnology, information and communication technology, space, mining and innovation policies. This agreement was followed by another MoU signed in 2005 between the

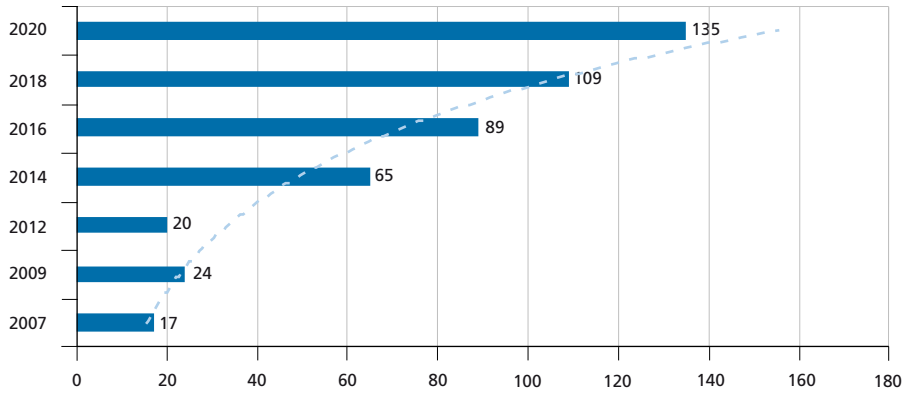
3. According to information from the Brazilian MCTI, partnerships with the United States, France and Germany were related to the establishment of ST&I institutions in Brazil in the 1950s, such as the National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq), the Coordination for the Improvement of Higher Education Personnel (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Capes), the Institute for Pure and Applied Mathematics (Instituto de Matemática Pura e Aplicada – IMPA), the National Nuclear Energy Commission (Comissão Nacional de Energia Nuclear – CNEN) and the Aeronautics Institute of Technology (Instituto Tecnológico de Aeronáutica – ITA). The ST&I cooperation between Brazil and these countries are diversified, with strong historical and cultural linkages, and governed by many bilateral agreements (Brasil, s.d.).

4. The ST&I cooperation relations between Brazil and the three mentioned Asian countries are oriented by high-level joint commissions established under bilateral ST&I agreements (Brasil, s.d.). A study by Fujita, Kwon and Fink (2013) reveals that the largest share of ST&I activities with South Korea originate in the higher spheres of public administration, characterizing a top-down approach, while few initiatives arise from the bottom-up context.

Brazilian Ministry of Education (MEC) and the Australian Department of Education (Australia, 2021; Brasil, 2005; 2019; 2021c).

According to Universities Australia (2022), partnership agreements between Australian and Brazilian universities and research centers increased from 17 in 2007 to 135 in 2020,[5] as seen in figure 1. Data collected by Universities Australia in 2021 (appendix) reveals that within each Australian university there are several institutes and university's research centers collaborating with Brazilian universities, with special highlight to growing joint projects in the areas of agriculture, veterinary sciences, earth and environmental sciences.

FIGURE 1
**Number of agreements between Brazilian and Australian universities**




Source: Universities Australia (2022) and Dese International Education, 2020.

People-to-people links also grew rapidly, in spite of the difficulties associated with the physical distance and huge time zone differences. Many Brazilian higher education students look for opportunities in Australia, either to foster their academic experience, to participate in collaborative research projects or even to relocate themselves in the job market. In 2010, only 727 undergraduate students were enrolled in Australian universities and, in 2021, this number grew to 2,016 enrolments. The launch of Science without Borders program in 2011 marked a milestone in Brazil's international academic cooperation and Australia became the 5th most popular destination for students. Since then, even after the program termination in 2017, Brazil still remains in the top 10 countries that sends students to Australia (Castro and Gallangher, 2021).

5. The number of partnership agreements remained stable from 2018 to 2020, according to the Australian Department of Education, Skills and Employment (Dese), International Student Data, 2020. Available at: <https://bit.ly/3H9qMA3>. Accessed on: Jan. 13, 2022.

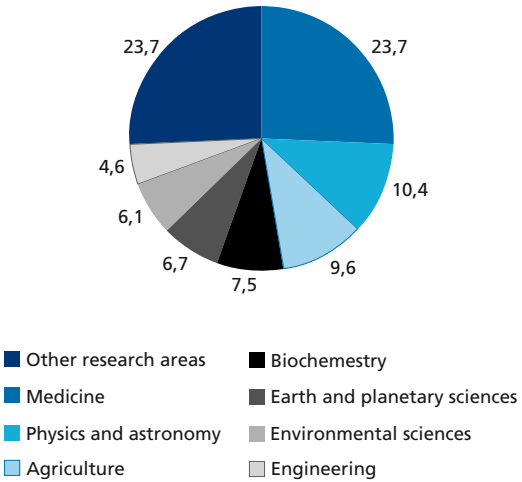
These accounts also consider students' enrolments in vocational education and training programs. In 2021,[6] there was a total of 16,601 Brazilians enrolled in Vocational Education and Training (VET) programs, the majority in areas related to management and commerce (Australia, 2021a; Universities Australia, 2022). Partly, one of the reasons for this observed growth in VET enrolments is the value placed on such diplomas and certificates for the purpose of working in Australia, facilitating individual registrations for work permits in the country, as well as necessary registrations for trade and commerce between both countries.

The increase in students exchange between Brazil and Australia can also be observed in the results of joint publication of scientific articles. According to the Scopus database, in 2020 there were only 97 collaborative scientific papers published by Brazilian and Australian researchers. In 2020, this number increased to 2,423 papers, sustaining the analysis of a mutual understanding and recognition of similarities and complementarities of joint research projects. The effect of international collaboration on Field Weighted Citation Impact, according to SciVal Platform, also increased when publications between Australian and Brazilian researchers are considered. In 2020 Brazil was Australia's 15th largest research partner globally and the largest research partner in Latin America, with a joint citation impact around 4.18. It represents an outstanding result if compared to 0.87 for Brazilians publishing alone and 1.58 for Australians publishing alone (McManus and Neves, 2021).

If considered the Brazilian positioning in the international scientific community, it can be said that Brazil has a relatively low level of international collaboration if compared to more developed countries. But if compared to the BRICS countries, Brazil has a higher level of participation (McManus et al., 2021). As per the Brazilian relationship with Australia, people-to-people linkages developed over the past decades are now showing a bigger result. According to the data produced by the Australian DESE, in regards to research snapshots,[7] in 2020 the top collaborating disciplines and research areas were medical and health sciences, engineering, biological sciences and physical sciences (Australia, 2020b). Figure 2 demonstrates how Brazil and Australia have been collaborating by subject area.

6. Available at: <https://bit.ly/3aOfu8t>. Accessed on: Jan. 13, 2022.
7. Available at: <https://bit.ly/3MznSWF>. Accessed on: Jan. 13, 2022.

FIGURE 2
**Co-authored publications by subject area (2016-2020)**




Source: SciVal Database. Accessed on: Oct. 28, 2021.

This significant growth in numbers related to higher education, science and research collaboration depicts the consolidation of a critical mass between Brazilian and Australian researchers. It reinforces the continuous growth in bottom-up cooperation ties among scientific and technological institutions from both countries, which led to the signing of the agreement between the government of Australia and the government of Brazil on ST&I, in 2017 (Brasil, 2021c).

The agreement reaffirmed the commitment of both countries to strengthen cooperation in the field of ST&I, in themes of mutual interest and benefit, by fostering a collaborative environment to innovation and the expansion of scientific knowledge capable to bolster economic growth. However, since the ratification process by the Brazilian Senate occurred only in 2021,[8] it is still pending the implementation of the Joint Committee for Cooperation in Science, Technology and Innovation, established by the referred agreement, to kick-off activities under the treaty.

## 2 METHODOLOGICAL APPROACH

This paper is based on primary sources of information, in the form of cooperation agreements in ST&I signed between Brazil and Australia, as well as documents referring to public policies of the two countries in these areas, obtained from databases and websites of governmental bodies of both countries. Other sources used were scientific articles and books on international cooperation in ST&I,

8. Available at: <https://bit.ly/3tpBqwX>. Accessed on: Dec. 19, 2021.

regarding the bottom-up and top-down approaches of international cooperation in ST&I. Documents and other references to specific cases of bilateral cooperation discussed in this paper, as individual and institutional initiatives that sustained a bottom-up approach to the cooperation between Australian and Brazilian researchers, were also used.

The paper is organized into three chapters, in addition to the introduction and the final considerations. The first chapter presents a historical overview of the bilateral cooperation in ST&I, developed from people-to people linkages to the signing an international high-level political agreement. In the second chapter, cases of partnerships carried out by institutions from governmental, academic and private sectors of both countries, exemplify the development of bottom-up relationships between the scientific communities and institutions which led to an inevitable thickening of the ST&I cooperation. The third chapter addresses characteristics of the Brazilian and Australian ST&I systems and policies, highlighting guidelines and priorities for international cooperation in both countries' ST&I policies, with a view to the implementation of the Joint Committee.

Written in a descriptive and exploratory style, the paper has the central hypothesis that ST&I cooperation between Brazil and Australia was built upon people-to-people and institution-to-institutional linkages, which characterizes a bottom-up approach to public policies. These individual linkages not only allowed the development of mutual understanding of both countries research community, but led to the signature of a national framework for cooperation in ST&I. The individual cooperation cases analyzed sustain the hypothesis, making the case of Brazil and Australia a unique case for political analysis.

## 3 A BOTTOM-UP COOPERATION STRATEGY BUILT UPON PEOPLE-TO-PEOPLE LINKAGES

International collaboration has become central to tackle global challenges, such as climate changes, water management, sustainable development as well as tropical diseases epidemics. These are globally recognized problems that require countries to work together to find innovative solutions. Either due to financial constraints, infrastructure and technological requirements, technical staff expertise, time pressure or even undesired socioeconomic impacts, the fact is that countries need to come together in order to face these challenges.

International relations focused on ST&I cooperation can be built upon interactions between national states, following strategies established by high-level political actors, as a top-down perspective. They can also be developed from individual initiatives arising from academic, applied research or business institutions, in which case activities emerge from common interests and needs of

two or more countries, regarded as a bottom-up approach (Wagner, 2002; Cruz Junior, 2011; Fujita, Kwon and Fink, 2013). Despite the importance of guidelines, priorities and activities defined at the governmental higher levels, or the lack of national frameworks for ST&I agreements, it is nowadays understood that modern science and research are increasingly being built on collaborations that surpass national borders, political divergences and socioeconomic conditions.

Cooperation in ST&I has expanded in the general framework of relations between Brazil and Australia, in the last two decades, including federal and state institutions, universities and research centers, as well as the private sector. Having been initiated from a bottom-up approach, pushed by joint research projects implemented by scientists from both countries, these partnerships have gained political relevance since 2001. However, it was from 2010 onwards that there was a boost in the high-level engagement,[9] when an Enhanced Partnership Agreement between Brazil and Australia was signed, further raised to a Strategic Partnership in 2012 (Australia, 2021c).

On February 13rd, 2001, the Ministry of Science and Technology of Brazil and the Department of Industry, Science and Resources of Australia signed a MoU in order to establish a joint science and technology cooperation program, when the following priority areas were defined for cooperation: biotechnology, information and communication technology, space, mining and innovation policies.[10] Nevertheless, the instrument presented limited results to promote coordination and the deepening of bilateral cooperation in science and technology. At the time, the Australian side resisted the conclusion of a bilateral agreement, advocating rather for the establishment of greater critical mass between Brazilian and Australian entities in the technical, technological and scientific areas (Brasil, 2019).

On April 24th, 2005, the governments of both countries signed the MoU for Cooperation in Education and Training, which was revised under the MoU between Brazil and Australia for the establishment of an Enhanced Partnership, signed on September 21st, 2010, with a view to reflecting priority updates. The areas of mutual interest under the Enhanced Partnership included science and technology, academic collaboration, as well as vocational education and training (Brasil, 2005; 2010).

Provisions related to science and technology defined that the governments of both countries would "pursue the conclusion of a Framework Agreement on Science and Technology" and "explore the possibility of developing common projects of research and development, in areas such as Agriculture, Mining,

9. Available in: <https://bit.ly/3H7hgNV>. Accessed on: Feb. 28, 2022.
10. Available at: <https://bit.ly/3mqCsoK>. Accessed on: Dec. 19, 2021.

Energy, Biotechnology, Nanotechnology and Space Sciences". For its turn, provisions related to higher education and vocational education and training indicated that the relations promoted under the MoU signed in 2005 "will be further developed by the governments of both countries by participation in activities oriented towards exchange of knowledge and experience which foster the achievement of common goals" (Brasil, 2010, p. 3-6).

Encouraged by the positive results of the Enhanced Partnership, Brazil and Australia raised their relations to the level of Strategic Partnership on June 21st, 2012, on the occasion of the United Nations Conference on Sustainable Development (Rio+20). In the Joint Statement of the Strategic Partnership, both countries reiterated and added new interests to those already identified in previous bilateral instruments, diversifying and boosting the establishment of partnerships between higher education institutions in both countries. Whereas it provided for more ambitious goals in areas where the relations achieved positive results, such as academic collaboration, the document maintained the goal of reinforcing some areas of incipient progress, such as joint scientific and technological projects. The number of official partnerships between Australian and Brazilian universities rose rapidly, following the growing interest of both countries in combining efforts for scientific research (Pfeiffer, 2017; Brasil, 2019).

On July 3rd, 2015, the Australian government Dese and the Brazilian MEC signed the MoU on Education, Research and Vocational Education and Training. Cooperation between countries included policy dialogues and exchange of information in areas of mutual interest, as well as fostering linkages between higher education, science and research, and vocational education and training institutions. Through this framework, collaborative academic programs, exchange of students, academics and researchers, conferences and symposia, and even exploratory joint projects have been implemented (Australia, 2015a).

In the Joint Statement regarding the Strategic Partnership between Brazil and Australia it was welcomed "the planned signature of the Agreement on Cooperation on Science, Technology and Innovation, which will support and enhance collaboration among research institutions and industries from both countries" (Brasil, 2012). Finally signed on September 7th, 2017, and recently enacted by Decree No. 10,772/2021, the agreement supports bilateral approximation efforts in ST&I and systematizes understandings already signed between universities and research institutions in both countries. The implementation of the agreement will be carried out by implementation protocols and by the Joint Committee for Cooperation in Science, Technology and Innovation (Brasil, 2018; 2019; 2021c).

## 4 CASES OF BOTTOM-UP COLLABORATIVE RESEARCH PROJECTS BETWEEN BRAZIL AND AUSTRALIA

As presented in the previous section, even before the Agreement for Cooperation on Science, Technology and Innovation between Australia and Brazil was ratified by the Brazilian Congress, in 2020, several shared research projects between Brazil and Australia, particularly in key industry sectors and related to science, technology, engineering and mathematics (STEM) development capabilities, were recipients of funds from both countries. The lack of a bilateral framework agreement for cooperation in ST&I did not hold back the establishment of key partnerships for collaborative research between Brazilian and Australian federal and state institutions, universities and research centers, or even private institutions from both countries.

Innumerous initiatives paved the way to the signing of a high-level political agreement, which is currently at the phase of discussing its first Joint Committee for Cooperation in Science, Technology and Innovation between Brazil and Australia. Several motivations can be highlighted when analyzing these initiatives. In some cases, federal institutions partnered after identifying a common interest on a multilateral forum. At the state level, similarities in the economic sectors or shared sustainable development challenges were observed at the core of a bilateral partnership. In the case of private sector partnerships, trade and commerce opportunities, as well as scientific-technological complementarities, were the driving forces behind these linkages. And in regards to universities and research centers networks, some of the motivations related to attracting and developing students and researchers' global competencies.

As a result of these initiatives, not only an inevitable thickening of the ST&I cooperation among researchers could be seen, but also a growing number of international collaborative research networks engaging Brazilian and Australian experts in several research areas. Through these networks, chief researchers from both countries' institutions could explore similarities and complementarities in ongoing research initiatives, and even expand their geopolitical perspectives and scientifical influence in the adopted paradigm for addressing a local problem.

### 4.1 Embrapa-CSIRO

In the agricultural sector, the Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária – Embrapa) and the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) first signed an MoU in 2010,[11] with the goal to establish an enhanced partnership for scientific and research cooperation between both agencies. By supporting institution-to-institution and

11. Available at: <https://bit.ly/3NZK7Gf>. Accessed on: Feb. 28, 2022.

researcher-to-researcher linkages, the political intention was to create opportunities for researchers with common challenges and expertise to meet. This agreement was renewed in 2019,[12] prioritizing the semiarid region as a cooperation theme, since the development of pastures for the region subjected to limited rainfall is a major challenge in both countries (Marsicano, 2019).

Additionally, due to climate and geographic similarities between Brazil and Australia, this initiative opened the opportunity for at least 20 research units from Embrapa to cooperate with Australian research institutions in topics related to plant and animal breeding, irrigation and water resource management, animal health, with emphasis on disease control, integrated insect management with emphasis on biological control, and environmental rehabilitation and ecosystem services. Agricultural innovations are driving improvements in productivity, profitability, sustainability, aquaculture, horticulture and the food industry. Based on the concept of participative and integrated partnerships, this latest agreement aimed at bringing together both countries experts to jointly explore beneficial solutions to the community, industry and the academia (Marsicano, 2019).

The case of cooperation between Embrapa and CSIRO is a unique case, as it refers to a strategic collaboration between two major national scientific research agencies governed as a network of institutes. This network-to-network partnership is considered a milestone in both governments high-level political sphere, central to pursue the conclusion of a framework agreement on science and technology between Australia and Brazil, as it demonstrates the mutual benefits from shared research projects in one of the main economic sectors for both countries trade balance – the agricultural sector.

### 4.2 ITV-CSIRO

Another singular case of bottom-up collaboration between Brazil and Australia refers to the partnership connecting CSIRO and the Vale Technological Institute (Instituto Tecnológico Vale – ITV).[13] One of the few international collaborative research projects engaging a Brazilian industry partner, the CSIRO and ITV joint project was implemented in the Australian state of Tasmania and the Brazilian state of Para.[14] The goal was to monitor the bees' behavior, by attaching a micro-sensor at the bees' backs, in order to assess the influence of pesticides use and severe climate events in the environmental sustainability of both monitored states (Ereno, 2014).

A Brazilian researcher based in Australia and working at CSIRO data 61 institute was ahead of this project titled "bees with backpacks". The micro-sensing technology

12. Available at: <https://bit.ly/3H3dF3v>. Accessed on: Jan. 14, 2022.
13. Available at: <https://bit.ly/3MA2fFz>. Accessed on: Feb. 28, 2022.
14. Available at: <https://bit.ly/3H5zn6W>. Accessed on: Feb. 28, 2022.

developed allowed tracking bees on the territory, how far they traveled and the time they spent away from the hive. The results allowed researchers to analyze the effects of pesticides, air pollution, climate conditions and even mining operations on the movement of the bees and their ability to pollinate, which is a basic condition for environmental sustainability of monitored regions (Ereno, 2014).

### 4.3 ANA-DFAT

In the water management research area, the Brazilian National Water Agency (Agência Nacional de Águas e Saneamento Básico – ANA) and Australian Department of Foreign Affairs and Trade (DFAT) signed an MoU, providing an important framework for technical cooperation between countries on water scarcity and the efficient management of water resources. Signed between federal institutions of both countries, this MoU actually aims at sustaining and fostering research collaboration among universities in Australia specialized water research, gathered under the Australian Rivers Institute Network, and ANA research staff. Australia has targeted a niche research expertise of drought management organized under the Australian Water Partnership. Established in 2015, this partnership gathers a network of researchers in Australia and internationally. Since Brazil and Australia have areas that are well-known for their dry climates, such as northeast Brazil and the desert regions in Australia, both countries have joined efforts to exchange scientific knowledge and discoveries in this field of research (Teixeira et al., 2021).

This MoU already produced other tangible outcomes, including the establishment of the Tropical Water Research Alliance (TWRA)[15] to foster connections between Brazilian and Australian academics and researchers, and the delivery of distance learning on Problems and Solutions for Water Basin Management by the Federal Institute of Education, Science and Technology of São Paulo (IFSP). Through the Brazilian TWRA, comprised of 10 Brazilian states research groups, several specialized cycles of webinars were developed since 2020, with the participation of Australian researchers, allowing an integrated participation of members from the scientific community, public authorities, productive sector as well as civil society in the discussions of sustainable water management and current environmental crisis faced by both countries.

### 4.4 Confap-Dese

More broadly regarding the research fields, after a two years negotiation between the Australian government Dese and the Brazilian National Council of State Funding Agencies (Conselho Nacional das Fundações Estaduais de Amparo à Pesquisa – Confap), a research collaboration MoU was signed in 2020. The

15. Available at: <https://www.thetwra.org/>. Accessed on: Jan. 14, 2022.

main objectives of this MoU are to promote international awareness in Australia and Brazil of each other's research capabilities, as well as to identify and nurture international cooperation opportunities and partnerships between Australian and Brazilian researchers and institutions. It also paves new ways for these researchers to access both countries' expertise, research funds and infrastructure, nationally and internationally, in areas of common interest (Confap…, 2021).

As a result, the first Australia–Brazil Virtual Research Collaboration (VRC) on the topic of covid-19 (Confap…, 2021) was implemented in 2021. The VRC highlighted some health-related and covid-19 research collaborations already in place between experts from Australia and Brazil, providing a forum to strengthen people-to-people existing collaborations. It also imparted opportunities for experts to network, explore and develop new joint research, thus leading to a broader institution-to-institution partnerships. The initiative counted with the support of the Australian Academy of Science (AAS) and the Brazilian Academy of SSciences (Academia Brasileira de Ciências – ABC) (Confap…, 2021). Despite the relevance of this initiative and its promising results, it is still early to assess concrete achievements.

### 4.5 Parana state-Victoria state

Regarding state-to-state collaborations, the case of Parana state in Brazil and the state of Victoria in Australia is a unique benchmark of research collaboration between both countries sub-national political entities. With activities implemented under a bilateral MoU since 2016,[16] several universities agreement have been fostered successfully, including the opening of two rounds of bilateral funding for university-led joint research projects with the support of Fundação Araucária (Assessoria de Comunicação da Seti, 2015).

Under these funding opportunities, some key results were observed, such as the La Trobe University and the State University of Maringa initiative in incorporating ecosystem goods and services into water management. Another outcome refers to the La Trobe University, the Federal University of Paraná and the State University of West Paraná initiative on capacity building for primary care responses to domestic violence in regional Brazil. And there is also the Swinburne University, Deakin University and the Federal University of Paraná project on low-cost sensors for water quality control. It is important to highlight that this last project is developed in partnership with Paraná Sanitation Company (Companhia de Saneamento do Paraná – Sanepar), the water supply and sewage treatment company at Parana state, which partnered with national and international researchers, through the Fundação Araucária MoU with Victoria state, in order to solve its operational challenges of improving the water quality control (Assessoria de Comunicação da Seti, 2015).

16. Available at: <https://bit.ly/392Za30>. Accessed on: Jan. 14, 2022.

### 4.6 Australia-Brazil-Chile network of regenerative medicine

In the São Paulo state, there is also a unique research partnership established between São Paulo Research Foundation (Fapesp) and the Australian Regenerative Medicine Institute at the Monash University (Famous…, 2021), from the state of Victoria in Australia (Famous…, 2021). The Fapesp-Monash University Collaboration Seed Program (Famous)[17] aims to provide matching funds for collaborative projects on health sciences and regenerative medicine related themes. Considering the need to provide a platform for further post-pandemic scientific engagement, the program encouraged collaborative activities with minimal travel expenditures and more prominent online collaboration activities (Fapesp, 2021).

In 2021 around 100 medical researchers could connect and establish in-depth network with matching partners from Australia, Brazil and Chile. The ABC Network demonstrates that international collaboration is critical in key areas, such as biomedical research and health sciences, as this theme is a global endeavor and the outcomes from these researchers have global impacts in improving the quality of life of patients (Fapesp, 2021). Cross-country and cross-cultural partnerships allow different perspectives on the same subject to be considered, catalyzing creativity, innovation and new ways of approaching the same issue.

### 4.7 Unesp-UQ

Still in São Paulo, there is a singular strategic partnership in place between the São Paulo State University (Universidade Estadual Paulista – Unesp) and the University of Queensland (UQ) in Australia (Castro and Gallangher, 2021). This is a case of a bilateral university agreement focused on setting tactical partnerships at the centre of the internationalization strategy. Rather than expanding the number of international partners, both universities decided to analyse each other strengths and complementarities in order to consolidate in-depth research and academic cooperation.

With the aim to develop student's global competencies and further internationalize its research capabilities, Unesp partnered with UQ to redefine the learning outcomes of its courses and programs, as well as to pursuit global excellence in research. By supporting international collaborative research networks and alliances, through which mobility of various academics and researchers' cooperation actions are supported, both universities intend to expand their impact in global science and research. A major outcome of this partnership is the expansion of the Global Research Alliances, in the areas of tropical agriculture and forest production systems, animal production, and bioeconomy. Another outcome refers to the establishment of the Global

17. Available at: <https://bit.ly/3Qd2b1u>. Accessed on: Jan. 14, 2022.

Bioeconomy Alliance, in a triple partnership between Unesp, UQ and the Technical University of Munich in Germany.[18]

Overall, UQ currently maintains only eleven agreements with ten research and higher education institutes in Brazil, including the Fapesp.[19] UQ case shows that Australian institutions are being selective when partnering with Brazilian institutions, by choosing partners that can help strengthen the university profile to deliver globally significant research, as well as support the creation of meaningful international research networks.

### 4.8 PUCRS Center of Internationalization of Education Brazil-Australia

Finally, another case to be highlighted is the establishment of the Center of Internationalization of Education Brazil-Australia, in partnership with the School of Humanities of the Pontifical Catholic University of Rio Grande do Sul (PUCRS). Conceived to become a hub in Latin America of the ioc.global[20] movement, the center counts with the support of Dese, the Australian embassy in Brazil, as well as partner universities such as Curtin University and La Trobe University. It has been structured to advance principles and practices of internationalization at home in the Latin-American region. For that purpose, some of the mechanisms utilized are the promotion of transnational education, the fostering of the bilateral partnership using existing people-to-people and researcher-to-research links, and the building sustainable academic activities, including the implementation of virtual research matchmaking between both countries' academics[21] (Faria and Cassol, 2021).

The center can be pitched as a result of the Australia-Americas PhD Research Internship Program, implemented by the Australian government Dese, from 2017 to 2020, in partnership with the Brazilian network of the Pontifical Catholic Universities (PUCBR Network) and with the support of the AAS. The Internship Program shares the same principles and understanding explored by Mitchell (2021) that shorter student mobility programs, with up to three months of international experience, is sufficient to break down cultural barriers, foster global networks and allow researchers to know better each other work in order to develop collaborative research projects. Whether the aim is the development of

18. Available at: <https://bit.ly/3tqeQEE>. Accessed on: Jan. 14, 2022.

19. Available at: <https://bit.ly/3xjMP2K>. Accessed on: Feb. 28, 2022

20. The internationalization of the curriculum (IoC) movement is a volunteer movement that gathers researchers and professors from across the globe. It began as an outcome of Betty Leask's Australian Government-funded National Teaching Fellowship in 2010-11 entitled "Internationalisation of the Curriculum in Action". In 2013-14, the work of the fellowship was extended with further support from the Australian Government's Office of Learning and Teaching. The second project, "Embedding the IoC in Action Framework", led by Craig Whitsed and Wendy Green, produced additional resources that support the process of internationalising the curriculum within whole degree programs. Detailed information and resources can be accessed on: <www.ioc.global>.

21. Available at: <https://bit.ly/3tu68oG>. Accessed on: Feb. 28, 2022.

institutional partnerships with key international partners, or the strengthening of collaborative networks with members from different countries, the fact is short-term mobility is enough to establish deep connections, and for that purpose the selection process of candidates must considers this intended outcome from the beginning (Faria and Cassol, 2021).

Since its establishment, the center has been beneficiary of Australian grants to implement its activities. In 2021, a grant from the Council on Australia Latin America Relations (Coalar)[22] was approved for a joint partnership between the PUCRS center and Curtin University to develop higher education faculty and staff capabilities to internationalize the curriculum, by using an internationalization of the curriculum (IoC) framework adapted to the Latin American cultural and institutional environment. This initiative, though led by two institutions only, was based on the mobilization of a Latin-American network of experts in IoC. Overall, 42 experts from 8 countries in the region have been mobilized to build and validate the framework, based on the Australian IoC framework (Australia, 2021d).

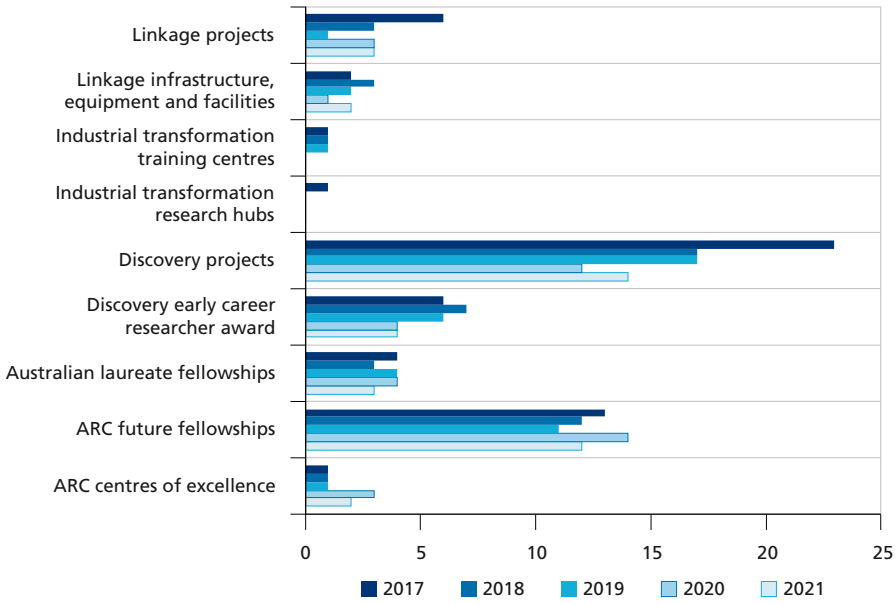
### 4.9 Additional remarks

As discussed in the cases above presented, Brazil and Australia have been gaining space in the global science and research scenario by joining strengths and capabilities. By working in solidarity, sharing knowledge and expertise, converging resources and infrastructure, researchers can contribute to creating innovative solutions. Australia is responsible for around 4% of all scientific contributions to the international community, many of which were materialized due to international collaboration, including Brazil. Figure 3 details the types of partnerships established between Brazilian and Australian researchers, from 2017 to 2020, according to the intent of each funding scheme.

Discovery projects and awards, as well as laureate and future fellowships, are funding schemes oriented towards the recognition of the importance of fundamental research to the innovation system. They aim to strengthen capability in fundamental research that may lead to innovative ideas, creation of jobs, economic growth and an enhanced quality of life. Linkage projects and grants, for infrastructure, equipment and facilities, refer to funding schemes aimed to encourage and extend cooperative approaches to research and improve the use of research outcomes. They also promote international research partnerships between researchers and business, industry, community organizations by strengthening links within Australia's innovation system and with innovation systems internationally.

22. Available at: <https://bit.ly/3NwjVTD>. Accessed on: Jan. 14, 2022.

FIGURE 3
**New and ongoing Australian Research Council (ARC) funded projects collaborating with Brazil**




Source: ARC Grants and Funding. Accessed on: Nov. 18, 2021.

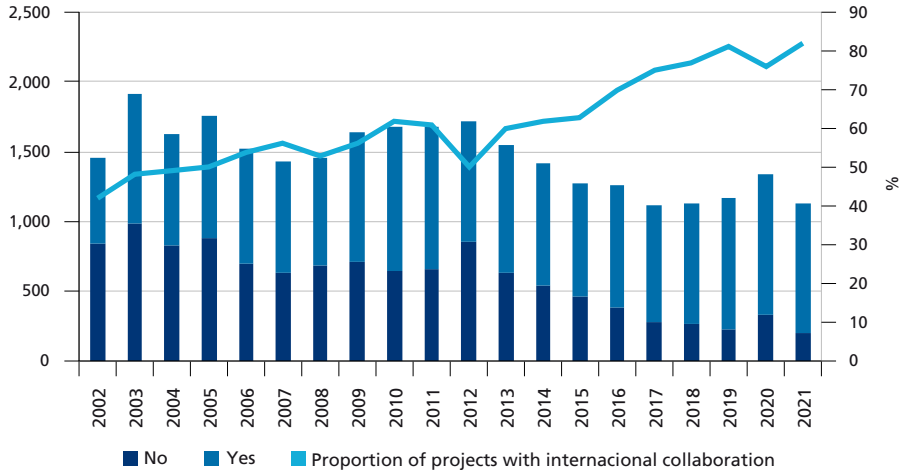
In general, grants related to discovery phases of the research and innovation, as well as fellowships, are the entry door for researchers to explore and connect with new international partners. Once this initial phase of analyzing and comprehending each other strengths and capabilities, the next phase is the submission of a project proposal for linkage projects or even for a joint collaboration under an Australian Center of Excellence or Industrial Transformation Hub. This is the reason why, in this 5-year period portrayed in figure 3, a decrease in the number of Brazilian researchers participating in discovery projects and awards can be observed. Additionally, one of the conditions to plead for next phases of the projects is to have a business, industry or community organization as a partner or direct beneficiary.

According to data from the ARC,[23] in around 60% of the research projects funded by the council under global competitive grants, aimed at brokering partnerships between researchers, industry and the private sector, close to 80% of the activities are implemented in collaboration with international partners (Australia, 2022). Figure 4 demonstrates the growth over the past two decades in the international collaboration arrangements made by Australian researchers

23. Available at: <https://bit.ly/3MqbrfG>. Accessed on: Jan. 13, 2022.

to engage with global partners in joint applied research for industry and private sector projects.

FIGURE 4
**International collaboration on ARC-funded projects**




Source: ARC Grants and Funding. Accessed on: Nov. 18, 2021.

In this case, it is important to notice that Brazil represents only 1% of the international collaboration in joint research projects funded by the ARC, in collaboration with industry and private sector partners. Despite the sustained growth in people-to-people linkages, institutional partnerships among universities and research centers, and even between governmental institutes, the engagement of ST&I between Brazilian and Australian researchers still lacks arrangements to bring industry and the private sector closer. Hence, this data points out to a new window of opportunity for Brazilian and Australian researchers to explore industry and the private sector collaboration in ongoing ST&I agreements and partnerships.

## 5 BRAZIL AND AUSTRALIA SYSTEMS AND STRATEGIES FOR INTERNATIONAL COOPERATION IN ST&I

In light of the historical record presented above, and with a view to the upcoming implementation of the Joint Committee, it is relevant to briefly discuss each country's national system of ST&I, including their actors, priority areas, main goals and general indicators, as well as both countries' strategies for international cooperation in these fields.

Brazil and Australia are countries that share a relevant similarity in its political organization as Federative States. State organizations have a strong influence in shaping public policies' design and implementation strategies, contributing to

their effectiveness. Federative systems are characterized by the union of political entities, typically found under democratic regimes, with the aim to organise the management of a national territory with shared responsibilities. However, some varieties in the Federative models must be bear in mind, in special regarding the autonomy of states and the political-administrative organization of the federal government, in order to understand specific characteristics of both countries ST&I systems and strategies.

In Brazil, the creation of the Union resulted from the independency process after an imperial period, resulting in a disaggregation process when creating the states. As a result, the political-administrative organization in Brazil is far more centralized than in Australia, where states have a larger share of legislative attributions and a bigger autonomy to shape the implementation of national policies (Arretche, 1996; Farah, 2001; Abrucio, 2010). In Australia the formative process of the federal entity – the Commonwealth – occurred through the aggregation of pre-existing colonies, which led to a bigger autonomy of states under the federative pact (Aroney, 2009).

In spite of the decentralization resulted from the Administrative Reform of the 1990's, Brazil remains as a highly centralized federative government in which the federal government maintains a certain prominence in the process of designing and implementing national policies. The centralization process in Brazil is materialized in the creation of national systems, plans and programs with incentives for adherence combined with conditionalities and specific requirements that reduces states' autonomy in the design and implementation of public policies. Whereas in Australia, the Commonwealth exercises a conciliatory role in the dialogue and convergence of the states' positions in propositions of national policies, as does the "National Cabinet". However, the legislative centre and responsibility for the effective application of public policies remain as a core responsibility of the states, who are accountable for its outputs and outcomes.

### 5.1 Brazilian system of ST&I

The Brazilian National System of Science, Technology, and Innovation (Sistema Nacional de Ciência, Tecnologia e Inovações – SNCTI) is composed by political actors from the Executive and Legislative branches in the federal, state, and municipal levels, and by research associations, business and union representations, as well as by funding agencies and operators of the system, such as universities, research institutions, innovative companies and science and technology parks (Brasil, 2016).

Political actors such as the MCTI, coordinator of SNCTI, the Brazilian Confap and the ABC are responsible for the definition of strategic guidelines for the system's initiatives. Funding agencies such as the Brazilian CNPq, the

Capes, the Funding Agency for Studies and Projects (Financiadora de Estudos e Projetos – Finep) and the Brazilian Company of Research and Industrial Innovation (Empresa Brasileira de Pesquisa e Inovação Industrial – Embrapii) manage instruments which allocate public resources in order to enable the implementation of decisions taken at the federal level.

According to the National Strategy of Science, Technology and Innovation (Estratégia Nacional de Ciência, Tecnologia e Inovação – ENCTI) 2016-2022, Brazil has stood out in several ST&I sectors due to large investments made in recent years with the objective of accelerating the country's scientific and technological development. Research and development (R&D) investment increased from R$ 12.5 billion to R$ 79.9 billion in the period of 2000 to 2018. In the majority of those years, most of the R&D investment was made by the public sector. Nevertheless, the resources invested in 2018 corresponded to only 1.14% of the country's GDP, far from the goal of 2% established by ENCTI (Brasil, 2016; 2022).

Nonetheless, ENCTI recognizes the weakening of the main Brazilian public instrument for funding ST&I activities, the National Fund for Scientific and Technological Development (FNDCT), in the last decade. A significant portion of FNDCT resources has been allocated as a contingency reserve – in 2021, it was approved the allocation of only R$ 534 million from the nearly R$ 5.6 billion that composed the fund (Andrade, 2021). More recently, in February 2022, the federal government announced the allocation of resources derived from a release in the blocked funds, an amount of almost R$ 1 billion, for the development of research, payment of scholarships and other actions in different areas, such as biotechnology, internet of things, agriculture and health (Brasil, 2022a).

In the period 2015 to 2020, Brazil maintained the 13$^{th}$ position in the global production of research publications, when around 372,000 articles were produced with the participation of at least one author linked to Brazilian institutions. In 2020, the Brazilian share reached 3.2% of world production. The research areas with the highest number of indexed articles in the period 2015-2020, according to the classification used by Web of Science (WoS), were engineering, chemistry, agriculture, and environmental sciences and ecology. The area of parasitology stands out among the research areas of global scientific production with the highest relative participation of Brazilian institutions – 15.5% of all production had the participation of an author linked to a Brazilian institution. The following areas are tropical medicine (14.3%), dentistry (12.9%), agriculture (11.1%) and forestry (11.1%) (CGEE, 2021).

Despite the prominence of Brazilian science, the country is ranked in lower positions in innovation indicators. Brazil was ranked 57$^{th}$ out of 132 countries in the Global Innovation Index (GII) published in 2021, improving by five positions

and achieving its best rank since 2012. The country was also ranked 11th in the upper-middle income group and 4th in Latin America and the Caribbean, after Chile, Mexico and Costa Rica (Dutta, 2021).

With the aim of placing the country among the top 20 positions of GII, the Brazilian government launched the National Innovation Policy in 2020, which was the precursor of the National Innovation Strategy initiated in 2021,[24] composed of initiatives representing the main points that demand attention in the form of public policies. International partnerships are mentioned in several of the listed initiatives, related, for example, to managing R&D infrastructure and innovation environments, raising foreign financial resources for research, development and innovation (RD&I) and attracting students, young talents and researchers from abroad (Brasil, 2021a).

ENCTI provides that the following subjects are considered as strategic areas for the Brazilian scientific and technological development: aerospace and defense, water, food, biomes and bioeconomy, social sciences and technologies, climate, digital economy and society, energy, strategic minerals, nuclear, health, and converging and enabling technologies (Brasil, 2016). These strategic areas are at the core of the debates with Australia regarding the implementation of the agreement between Brazil and Australia on ST&I.

Brazil has made continuous efforts of international cooperation in order to strengthen the SNCTI, with a view to achieving the country's goals of sustainable economic and social development. The last two decades has seen a considerable expansion of Brazil's international cooperation in ST&I, following the country's greatest projection on the international scene, in the political, economic and cultural levels. Based on ENCTI guidelines, efforts were made to complement national capacities through international cooperation activities and projects (Brasil, s.d.).

ENCTI establishes that the expansion, consolidation and integration of SNCTI shall be promoted by strengthening its five fundamental pillars, briefly named as research, infrastructure, financing, human resources and innovation. Priority actions associated to three of those pillars refer to international cooperation strategies: the pillar of "fostering basic scientific and applied research" includes the priority action of "encouraging international cooperation with leading countries and institutions in strategic areas"; the "modernization and expansion of the ST&I infrastructure" pillar mentions the action of "strengthening and implementation of national multi-user centers and laboratories in strategic areas, including in cooperation with global R&D centers"; and the pillar of "training, attracting and maintaining human resources" incorporates the action of "encouraging

24. Available at: <https://bit.ly/3mtn3Ux>. Accessed on: Jan. 13, 2022.

international mobility programs (…) at Masters and PhD levels, particularly by means of cooperative projects in strategic areas" (Brasil, 2016, p. 73-80).

### 5.2 Australian system of ST&I

Regarding Australia's ST&I system, and similar to Brazil, there are political and scientific actors both at the federal and state levels. The Australian Government Department of Industry, Science, Energy and Resources (Dieser)[25] take the lead on national policies and initiatives aimed at growing the Australian economy, develop its scientific and technological competencies, and improve the industries' capabilities. Key policy agendas refer to astronomy and space programs, renewable energy and the hydrogen industry, climate change and greenhouse emissions, as well as digital transformation and blockchain technology. Also among the science and research priorities there are transport, soil and water, food, health and natural resources (Australia, s.d.).

The Australia's National Science Statement,[26] dated from March 2017, recognizes science as fundamental to a sustainable economic growth and social wellbeing, setting a long-term approach to achieving a strong science system. It also positions the government to respond to the science elements of the 2030 Strategic Plan. The statement[27] provides guidance for government investment and decision making, including criteria such as encouraging and supporting collaboration across disciplines, sectors and internationally, and ensuring scientific research investment is focused on high-quality research, assuring it is stable and predictable. It also orchestrates Dieser engagement with the educational agenda from the Dese, by reinforcing the role of the universities to undertake activities along the spectrum from basic to applied research, across all disciplines, and assuring that the National STEM School Education Strategy 2016-2026 is taking action to lift foundational skills in STEM learning areas (Australia, 2017a; 2017b).

In regards to the international collaboration in ST&I, Dieser guidelines and the National Science Statement both target at increasing cooperation, connecting researchers, businesses and entrepreneurs to capitalize on strengths and complementarities of capabilities, and also further develop and commercialize innovative products and services. Through treaties and initiatives such as the National Innovation and Science Agenda's Global Innovation Strategy, Australia strengthens and expands its strategic international ST&I partnerships. Among the adopted strategies under the national plans, there are collaboration between

25. Available at: <https://bit.ly/3NOpZr7>. Accessed on: Feb. 28, 2022.
26. Available at: <https://bit.ly/3xe9a1p>. Accessed on: Feb. 28, 2022.
27. Key points from the Australia's National Science Statement are available at: <https://bit.ly/3NNUu0l>. Accessed on: Feb. 28, 2022.

individual scientists, research institutions and networks, and businesses. The government also encourages two-way mobility of scientists and researchers, from early to mid-career researchers to senior researchers, by supporting highly skilled scientists to work in and collaboratively with Australia.

The Australian government investment in research, science and innovation has grown considerably in recent years, from AU$ 6.6 billion in 2006-2007 to AU$ 10.1 billion in 2016-2017,[28] including direct support for research centers, universities, private sector business R&D, and multi-sector funding (Australia, 2015b). Announced in December 2015, the National Innovation and Science Agenda (Nisa)[29] committed AU$ 1.1 billion over four years to complement a broader government investment in science, innovation and research (Australia, 2015b). In 2020-2021 the budget allocated increased to approximately AU$ 11.9 billion. Australia's overall investment in R&D, as a percentage of GDP, ranks 15th out of 33 Organisation for Economic Co-operation and Development (OECD) countries, plus China, Taiwan and Singapore. The country also ranked 25th out of 132 countries in the GII published in 2021.

The Nisa agenda embraces critical areas in ST&I that are priorities for the federal government to power the country's economy and productivity. Along with advice from the chief scientist and bodies such as the Commonwealth Science Council and Innovation and Science Australia, Dieser works in coordination with key stakeholders to set a target for the National Science and Research Priorities, as well as systematizes the countries' strengths and gaps in its scientific capabilities. One of Nisa pillars is to support Australian entrepreneurs by opening new sources of financing and absorbing risks associated with technological innovation. Another pillar refers to foster industry and researchers' collaboration to find innovative solutions to key challenges, including the attraction of world-class talents in business and research (Australia, 2015b).

Based on the national ST&I policies, Australian states develop their own implantation strategies, designing projects, fostering collaboration between institutions and researchers, as well as seeking international partners. State governments understand their role in developing the territory economic growth, its industries competitivity and trade opportunities, not just for goods and services, but also for science and technology. Australian states are responsible to support companies doing business internationally and therefore have state agencies allocated to help the negotiations and trading of ST&I deliverables, investing in their own innovation ecosystems. These agencies, such as Trade

28. Available at: <https://bit.ly/3xe9a1p>. Accessed on: Feb. 28, 2022.
29. Available at: <https://bit.ly/3Q2HmWB>. Accessed on: Jan. 14, 2022.

and Investment Queensland (TIQ),[30] or Trade and Investment Victoria,[31] and Investment New South Wales,[32] develop their own funding opportunities oriented towards strengthening relationships between universities and research centers, boosting people-to-people links, and promoting commercial trade as well as fostering diplomatic ties.

Innovation and science themes are also at the core of the Australian federal and state governments educational policies, by orchestrating the reform process of the Australian Curriculum, supporting primary school teachers graduate with a subject specialization with priority to STEM disciplines, delivering entrepreneurs' programmes with the support of universities, reforming the employee share schemes to allow start-ups and spin-offs to attract world class staff, and improving regulation to adopting international standards where possible, among other measures. As a result, according the 2020 Survey of Commercialisation Outcomes from Public Research (SCOPR),[33] only in 2020 Australia registered 54 new spin-outs and start-ups focused on research commercialization, accumulating a total of 256 active spin-outs and start-ups. Altogether, knowledge commercialisation in Australia was responsible to generate AU$ 737 million in value of research contracts with for-profit companies and AU$ 242 million in commercialization revenue. In practice, it means that Australian commercialization revenue more than doubled in the post-pandemic recovery period, reinforcing the country position as a ST&I powerhouse (KCA, 2021).

A key stakeholder behind the orchestration of the ST&I and education policies is the ARC. Established in 2001 as an independent body under the Australian Research Act 2001, the ARC reports to Dese. It is responsible for funding excellent research and research training; measuring the quality, engagement and impact of research, either for the livelihood of the communities or for economic growth and productivity; and providing policy advice on research matters. The ARC also administers the National Competitive Grants Program (NCGP), through which it supports excellent research and research training across all disciplines, awarding funding on the basis of a competitive peer review process, and encourages partnerships between researchers and industry, government, community organizations and international partners, including Brazil.

Adding to the ST&I stakeholders of the country, Australia has more than 50 independent research institutes and 43 public and private universities that undertake scientific research, from basic to applied research. Among these

30. Available at: <https://www.tiq.qld.gov.au/>. Accessed on: Jan. 14, 2022.
31. Available at: <https://www.invest.vic.gov.au/>. Accessed on: Jan. 14, 2022.
32. Available at: <https://invest.nsw.gov.au/>. Accessed on: Jan. 14, 2022.
33. Available at: <https://bit.ly/3H5WbDu>. Accessed on: Jan. 14, 2022.

independent research institutes there are the CSIRO, Australian Institute of Marine Science, Australian Nuclear Science and Technology Organisation (ANSTO), Geoscience Australia, the Bureau of Meteorology, the Australian Antarctic Division, the Defence Science and Technology Group, and the Australian Centre for International Agricultural Research.

Universities and independent research institutes are spread around the country, many based in rural areas, playing a relevant role in the development of science and implementation of national and international research projects through the Cooperative Research Centers (CRCs). Established in 1990, the CRCs foster collaboration among universities and between public-private research centers to enhance major national challenges, as well as enhance the country's industrial, commercial and economic growth. Being run by universities, the CRCs projects offer opportunities for graduate and postgraduate students to take part in short-term industry-led collaborative research projects.

There is also the Industry Growth Centre (IGC) initiative, which is a strategic, sector-based program that aligns government activities to industry needs in order to grow industries' capabilities and create qualified jobs. In addition, there are numerous hospitals and other organizations that undertake research, for example the CSIRO, an agency of the Australian government that contributes to a diverse range of scientific research.

Between 2016 and 2020, Australia's research actors produced over 580,000 publications across all fields of research, nearly 3.8% of global output. Of those publications, over 300,000 were with international partners from over 200 different countries, and over 10,000 were with at least one Brazilian partner. This figure demonstrates a mutual commitment to joint scientific, research and innovation projects.

Regarding the funding system in Australia, there are major funds run by the federal government, adding to private sector investments and other international sources. The federal government operates a dual funding system for university-led research, made up of research block grants and competitive research grants. Research block grants aim to support the systemic costs of research, including the training of domestic and international students undertaking research doctorate and research master's courses. The Research Support Program provides funding to costs of research not supported directly through competitive and other grants, such as libraries, laboratories, consumables, computing centres and the salaries of support and technical staff. Additionally, the federal government runs numerous nationally competitive research grant programs through, for example, the ARC and the National Health and Medical Research Council (NHMRC). Most of these funds support projects and initiatives that are priorities under the Australian

government Nisa, through which a strong international research and business connections and collaborations have been fostered.

The Strategic University Reform Fund,[34] coordinated by Dese, encourages universities to undertake projects in priority areas that also have a strong link to local communities (Australia, 2021b). It also supports initiatives oriented towards the achievement of the National Infrastructure Investment Program,[35] which provides support for projects that meet Australia's infrastructure needs as identified in the National Infrastructure Roadmap, such as digital infrastructure, supercomputers, platforms for urban research and environmental information, as well as a network of data stores and services and a national research cloud offering digital tools and virtual laboratories (Australia, 2020a).

## 6 FINAL CONSIDERATIONS

Science and technology are evolving incredibly fast, creating benefits for every individual's life. Rethinking international cooperation through ST&I lenses, in face of growing global challenges, is an emerging role for governments, universities and science institutes, and researchers, to which bilateral high-level agreements can be of great value. In view of the current stage of ST&I cooperation between Brazil and Australia, both countries policy guidelines and statements, as well as the current developments for the implementation of the first Joint Committee, this paper sought to draw the attention of researchers and policymakers to the unique feature of a bottom-up approach to existing cooperation schemes, and to explore synergies for international cooperation opportunities and possibilities under both ST&I systems.

Although the positions of Brazil and Australia have traditionally converged in multilateral forums, in areas of common interest, strong partnerships and closer governmental linkages have been developed only over the past two decades. Considerable academic and researchers' mobility resulting from agreements between universities, state and federal institutions, and businesses have been at the core of both countries' ST&I cooperation approach. We expect that the information provided by this article may contribute to a better understanding of the international dimension of ST&I policies and existing mechanisms that may be accessed by researchers and institutions from both countries in order to seek jointly funded projects. There are several topics of shared interest, as well as complementing research capabilities and installed infrastructure, which allows the exploration of new areas of scientific and technological collaboration.

34. Available at: <https://bit.ly/399KhME>. Accessed on: Jan. 13, 2022.
35. Available at: <https://bit.ly/3O4kuE2>. Accessed on: Jan. 13, 2022.

However, it is important to recollect key features of the Australia ST&I system for forthcoming collaborative projects with Brazil, in order to have a bigger share in competitive grants managed by the Australian government. The first aspect refers to the Australia's National Science Statement, which prioritizes projects that contributes to build new scientific capabilities and skills with direct impact in the economy, environment and wellbeing of the population. Close partnerships with community, public managers and decision makers, industry and private sector representatives are fundamental to this approach. Additionally, researchers need to approach their project proposals considering the potential to transform its outputs into marketable products, services and processes, highlighting its commercialization potential. Therefore, linking world-class scientific developments with current community problems, opportunities for decision making applications, short-term industry needs and future trends, or considering the formation of a joint venture with one of more partners, are growing conditions for several applied research funds.

A second aspect refers to encouraging research collaboration across disciplines, cultural backgrounds and economic sectors, engaging both national and international partners. Collaborative solutions, bringing together teams from diverse disciplines and career stages, as well as economic sectors and cultural dimensions, is a high value asset to tackle global and local challenges. It includes engaging in project proposals not only community, decision makers, industry and private sector representatives, but also a mixed group of researchers – together with early and mid-career researchers – who can bring complementing views and approaches to the same challenge.

A third aspect refers to ensuring government support for stable and predictable research investments. Long term plans and goals are central to foster scientific development, from basic science to its applications, and to produce new research, knowledge and technologies. Long term guidelines articulate the role of governments and public funding in developing a strong and stable ST&I system, by securing a guide to decision makers and policy makers according to the country's intended outcomes.

In regards to the Brazilian ST&I system, the greatest challenge to broaden the international collaboration in ST&I refers to the formulation and implementation of long-term policies, with clear international guidelines, which could be boosted by the coordination of investments in the prioritized sectors. Lack of long-term policies and guidelines frequently impact in discontinuity of funding for ongoing research projects, especially in more advanced stages. It also affects the country position at global innovation ranks, as the capacity of researchers to demonstrate potential applications of scientific solutions to the community, industry and policy makers is weakened. Despite this challenge, it is worth highlighting the resilience of the Brazilian researchers and institutions, since the country's scientific production continued to grow even when facing budget constraints in the last decade.

Considering the limitations addressed above, in order to deepen and diversify the ST&I cooperation with Australian researchers and institutions need to explore priorities already stated under ST&I policies such as ENCTI 2016-2022 and the National Innovation Strategy of 2021. New windows of opportunity for bilateral projects and activities are also expanding after the consideration of Brazil to enter the OECD, as it requires advancements in the education, science and research fields, in special related to the ST&I regulations, the country's capacity to transform scientific knowledge into applications for industry development, community wellbeing and environmental sustainability. Partnering with Australia can be beneficial for sharing science and research policies benchmarks, identifying additional research capabilities and levering off complementing infrastructure.

The hopes are that the signing of this new ST&I agreement may foster the identification and facilitate the access to local and international networks of excellence existing in both countries, and even third parties, in pursuit of the development of innovative solutions to common problems and challenges that for the past two decades have brought together researchers from both Brazil and Australia in a unique bottom-up movement.

Based on the themes that inspired this research, there are several other aspects that deserve further study. A first topic could be an in-depth analysis of top-down and bottom-up approaches for international cooperation in ST&I, including studies/investigation of result-oriented and mission-oriented cooperation. Another topic could relate to the possibilities of new colonialism practices through ST&I international policies, as well as the role of science and innovation diplomacy in fostering researchers' approximation in spite of political borders. In particular, comparative studies on cooperation in ST&I between Brazil and different countries could reveal the prevalence of one or another of the mentioned approaches in Brazilian international cooperation in ST&I and other patterns and trends.

## REFERENCES

ABRUCIO, F. **Desafios contemporâneos para a reforma da administração pública brasileira**. In: PETERS, B. G.; PIERRE, J. (Ed.). Administração pública: coletânea. São Paulo: Unesp; Enap, 2010. p. 537-548.

ANDRADE, R. O. Ciência à míngua. **Pesquisa Fapesp,** n. 304, p. 34-40, jun. 2021.

ARONEY, N. **The constitution of a Federal Commonwealth**: the making and the meaning of the Australian constitution. Cambridge, United Kingdom: Cambridge University Press, 2009.

ARRETCHE, M. Mitos da descentralização: mais democracia e eficiência nas políticas públicas? **Revista Brasileira de Ciências Sociais**, v. 11, n. 31, p. 44-66, 1996.

ASSESSORIA DE COMUNICAÇÃO DA SETI. Paraná amplia parceiras com o estado australiano de Victoria. **Fundação Araucária**, 27 abr. 2015. Retrieved Jan. 14, 2022, from: <https://bit.ly/392Za30>.

AUSTRALIA. Department of Foreign Affairs and Trade. **Memorandum of Understanding between Australia and Brazil for the establishment of an enhanced partnership**. New York: DFAT, Sept. 21, 2010. Retrieved Feb. 28, 2022, from: <https://bit.ly/3NZK7Gf>.

_____. Department of Education, Skills and Employment. **Memorandum of Understanding on education, research and vocational education and training between the Australian Department of Education and Training and the Brazilian Ministry of Education**. Canberra: Dese, 2015a. Retrieved Dec. 16, 2021, from: <https://bit.ly/3MEsACA>.

_____. Department of Industry, Science, Energy and Resources. **National innovation and science agenda report**. Canberra: Commonwealth of Australia, 2015b. Retrieved Dec. 13, 2021, from: <https://bit.ly/3xtJhMA>.

_____. **Australia's National Science Statement**. Canberra: Commonwealth of Australia, 2017a. Retrieved Mar. 2, 2022, from: <https://bit.ly/3xe9a1p>.

_____. Department of Industry, Science, Energy and Resources. **Key points from Australia's National Science Statement**. Canberra: Diser, 2017b. Retrieved Mar. 2, 2022, from: <https://bit.ly/3NNUu0l>.

_____. Department of Education, Skills and Employment. **2020 research infrastructure investment plan**. Canberra: Dese, 2020a. Retrieved Jan. 13, 2022, from: <https://bit.ly/3O4kuE2>.

_____. Department of Education, Skills and Employment. **Research snapshots**. Canberra: Dese, 2020b. Retrieved Dec. 13, 2021, from: <https://bit.ly/3MznSWF>.

_____. Department of Education, Skills and Employment. **International student statistics by nationality**. Canberra: Dese, 2021a. Retrieved Jan. 13, 2022, from: <https://bit.ly/3aOfu8t>.

_____. Department of Education, Skills and Employment. **Strategic university reform fund**. Canberra: Dese, 2021b. Retrieved Jan. 13, 2022, from: <https://bit.ly/399KhME>.

_____. Department of Foreign Affairs and Trade. **Brazil country brief**: bilateral fact sheet. Canberra: DFAT, 2021c. Retrieved Dec. 13, 2021, from: <https://bit.ly/3H7hgNV>.

_____. Department of Foreign Affairs and Trade. **Internationalisation of education in Latin America**. Canberra: DFAT, 2021d. Retrieved Feb. 28, 2022, from: <https://bit.ly/3NwjVTD>.

_____. **NCGP trends**: international collaboration. Canberra: Australian Research Council, 2022. Retrieved Jan. 13, 2022, from: <https://bit.ly/3MqbrfG>.

_____. Department of Industry, Science, Energy and Resources. **Policies and initiatives**. Canberra: Diser, [s.d.]. Retrieved Mar. 2, 2022, from: <https://bit.ly/3NOpZr7>.

BRASIL. Ministério das Relações Exteriores. **Memorandum of understanding between the government of Australia and the government of Brazil on cooperation in the field of education and training**. São Paulo: MRE, Apr. 25, 2005. Retrieved Dec. 16, 2021, from: <https://bit.ly/3Q95aIa>.

_____. Ministério das Relações Exteriores. **Memorando de entendimento entre o governo da República Federativa do Brasil e o governo da Austrália para o estabelecimento de parceria reforçada**. Nova York: MRE, Sept. 22, 2010. Retrieved Dec. 16, 2021, from: <https://bit.ly/3zqjfLq>.

_____. Ministério das Relações Exteriores. **Brazil-Australia joint statement**: Rio de Janeiro, June 21, 2012. Brasília: MRE, 2012. Retrieved Dec. 19, 2021, from: <https://bit.ly/3HjJsgV>.

_____. Ministério da Ciência, Tecnologia, Inovações e Comunicações. **Estratégia nacional de ciência, tecnologia e inovação 2016-2022**. Brasília: MCTIC, 2016.

_____. Ministério da Ciência, Tecnologia, Inovações e Comunicações. Gabinete do Ministro. **Agreement between the government of the Federative Republic of Brazil and the government of Australia for Cooperation on Science, Technology and Innovation**. Brasília: Assin, 2018. (Nota Técnica, n. 4734/2018).

_____. Ministério da Ciência, Tecnologia, Inovações e Comunicações. **Material informativo para reunião entre o ministro Marcos Pontes e o embaixador da Austrália no Brasil, Timothy Kane, em 4 de setembro de 2019**. Brasília: Deaic; Sepla, 2019.

_____. Resolução CI nº 1, de 23 de julho de 2021. Aprova a Estratégia Nacional de Inovação e os planos de ação para os eixos de fomento, base tecnológica, cultura de inovação, mercado para produtos e serviços inovadores e sistemas educacionais. **Diário Oficial**, Brasília, p. 27, 2021a. Seção 1. Retrieved Jan. 13, 2022, from: <https://bit.ly/3mtn3Ux>.

_____. Ministério das Relações Exteriores. **Comunidade da Austrália**. Brasília: MRE, 2021b. Retrieved Dec. 13, 2021, from: <https://bit.ly/3H7ackg>.

_____. Decreto nº 10.772, de 20 de agosto de 2021. Promulga o acordo entre o governo da República Federativa do Brasil e o governo da Austrália para cooperação em ciência, tecnologia e inovação, firmado em Camberra, em 7 de setembro de 2017. **Diário Oficial**, Brasília, 2021c. Retrieved Dec. 19, 2021, from: <https://bit.ly/3tpBqwX>.

_____. Ministério da Ciência, Tecnologia e Inovações. **MCTI divulga investimentos de quase R$ 1 bilhão para a ciência, tecnologia e inovação nacional**. Brasília: MCTI, 2022a. Retrieved Mar. 2, 2022, from: <https://bit.ly/3mvyxqO>.

_____. Ministério da Ciência, Tecnologia, Inovações e Comunicações. **Indicadores nacionais de ciência, tecnologia e inovação 2021**. Brasília: MCTIC, 2022b. Retrieved Jan. 13, 2022, from: <https://bit.ly/3zqKC89>.

_____. Ministério da Ciência, Tecnologia e Inovações. **Cooperação Internacional**. Brasília: MCTIC, [s.d.]. Retrieved Dec. 19, 2021, from: <https://bit.ly/3zojBCk>.

CASTRO, J. C. F. de; GALLANGHER, J. Developing a strategic partnership: a concrete example from two Brazilian and Australian top universities. In: MOROSINI, M. et al. (Org.). **Internationalization of higher education**: practices and reflections from Brazil and Australia. Porto Alegre: EdiPUCRS, 2021. Retrieved Jan. 14, 2022, from: <https://bit.ly/3MCdrSa>.

CGEE – CENTRO DE GESTÃO E ESTUDOS ESTRATÉGICOS. Panorama da ciência brasileira: 2015-2020. **Boletim Anual OCTI**, v. 1, jun. 2021. Retrieved Jan. 13, 2022, from: <https://bit.ly/3H36uZ7>.

CIA – CENTRAL INTELLIGENCE AGENCY. Environment: international agreements. **The World Factbook**, 2022. Retrieved Feb. 22, 2022, from: <https://bit.ly/3H5nttU>.

CONFAP e Ministério Australiano (Dese) promovem evento virtual para conectar pesquisadores brasileiros e australianos com estudos relacionados à covid-19. **Confap**, Nov. 8, 2021. Retrieved Jan. 14, 2022, from: <https://bit.ly/3mxjmxj>.

CRUZ JUNIOR, A. S. **Diplomacia, desenvolvimento e sistemas nacionais de inovação**: estudo comparado entre Brasil, China e Reino Unido. Brasilia: Funag, 2011.

CSIRO – COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION. **Our achievements**: advancing Australia since 1916. Canberra: CSIRO, 2022. Retrieved Jan. 13, 2022, from: <https://bit.ly/3O43JJc>.

DUTTA, S. et al. (Org.). **Global innovation index 2021**: tracking innovation through the covid-19 crisis. 14th ed. Geneva: Wipo, 2021.

ERENO, D. Abelhas vigiadas. **Pesquisa Fapesp**, jul. 2014. Retrieved Feb. 28, 2022, from: <https://bit.ly/3MA2fFz>.

FAMOUS program launches, bringing together Australia and Brazilian scientists. **Armi**, Nov. 22, 2021. Retrieved Jan. 14, 2022, from: <https://bit.ly/3zlb0Ap>.

FAPESP – FUNDAÇÃO DE AMPARO À PESQUISA DO ESTADO DE SÃO PAULO. **Launch of Famous**: Fapesp and Monash University Collaboration Seed Program. São Paulo: FAPESP, Oct. 7, 2021. Retrieved Jan. 14, 2022, from: <https://bit.ly/3Qd2b1u>.

FARAH, M. F. Parcerias, novos arranjos institucionais e políticas públicas no nível local de governo. **Revista de Administração Pública**, v. 35, n. 1, p. 119-144, 2001.

FARIA, C. E.; CASSOL, C. C. A brief history about the Center of Internationalization of Education Brazil-Australia. In: MOROSINI, M. et al. (Org.). **Internationalization of higher education**: practices and reflections from Brazil and Australia. Porto Alegre: EdiPUCRS, 2021. Retrieved Jan. 14, 2022, from: <https://bit.ly/3MCdrSa>.

FUJITA, E.; KWON, Y.; FINK, D. Análise comparativa das trajetórias de produção de conhecimento entre o Brasil e a Coreia do Sul: tendências e possibilidades. In: BRASIL. Ministério das Relações Exteriores. **Mundo afora**: políticas de incentivo à inovação. Brasília: MRE, 2013. n. 10, p. 174-202. Retrieved Feb. 28, 2022, from: <https://bit.ly/39cleIQ>.

KCA – KNOWLEDGE COMMERCIALISATION AUSTRALASIA. **Survey of commercial outcomes from public research** (**SCOPR**). Crows Nest: KCA, 2021. Retrieved Jan. 14, 2022, from: <https://bit.ly/3H5WbDu>.

MARSICANO, K. Semiarid region a priority in cooperation between Embrapa and Embassy of Australia. **Embrapa**, Mar. 13, 2019. Retrieved Jan. 14, 2022, from: <https://bit.ly/3H3dF3v>.

MCMANUS, C. M. et al. Profiles not metrics: the case of Brazilian universities. In: **Anais da Academia Brasileira de Ciências**, v. 93, n. 4, 2021. Retrieved Feb. 28, 2022, from: <https://bit.ly/3NDYqQW>.

MCMANUS, C. M., NEVES, A. A. B. Some insights into internationalisation of postgraduate education from the Brazilian perspective. In: MOROSINI, M. et al. (Org.). **Internationalization of higher education**: practices and reflections from Brazil and Australia. Porto Alegre: EdiPUCRS, 2021.

MITCHELL, N. Shorter student mobility "widens participation": study. **University World News**, June 24, 2021. Retrieved Feb. 28, 2022, from: <https://bit.ly/39cxJUJ>.

PFEIFFER, H. **Brazil and Australia**: beyond the tyranny of distance. In: BARBOSA, P. H. B. (Org.). Challenges and opportunities in the Brazil-Asia relationship from the perspective of young diplomats. Brasília: Funag, 2017. p. 275-300.

SILVA, R. G. L. et al. The institutional building of science and innovation diplomacy in Latin America: toward a comprehensive analytical typology. **Frontiers in Research Metrics and Analytics**, v. 6, 2021. Retrieved Jan. 13, 2022, from: <https://bit.ly/3N7jiQu>.

TEIXEIRA, A. L. F. et al. Operationalizing water security concept in water investment planning: case study of São Francisco river basin. **Water**, v. 13, n. 24, 2021. Retrieved Feb. 28, 2022, from: <https://bit.ly/3mxEbc0>.

UNIVERSITIES AUSTRALIA. **International links (member universities)**. Deakin: Universities Australia, 2022. Retrieved Jan. 13, 2022, from: <https://bit.ly/39mBUx3>.

WAGNER, C. S. The elusive partnership: science and foreign policy. **Science and Public Policy**, v. 29, n. 6, p. 409-417, Dec. 2002.

APPENDIX

TABLE A.1
**Collaboration between Australian universities and Brazilian educational and research institutions (2021)**

| Institution | **Total** | Agriculture and veterinary sciences | Environmental sciences |
|---|---|---|---|
| University of Sydney | **128 collaborating institutions**<br>**1,293 co-authored publications** | 33 collaborating institutions<br>44 co-authored publications | 37 collaborating institutions<br>55 co-authored publications |
| University of Melbourne | **116 collaborating institutions**<br>**1,237 co-authored publications** | 21 collaborating institutions<br>25 co-authored publications | 22 collaborating institutions<br>27 co-authored publications |
| University of Queensland | **113 collaborating institutions**<br>**650 co-authored publications** | 34 collaborating institutions<br>86 co-authored publications | 44 collaborating institutions<br>58 co-authored publications |
| University of Western Australia | **95 collaborating institutions**<br>**465 co-authored publications** | 27 collaborating institutions<br>41 co-authored publications | 32 collaborating institutions<br>46 co-authored publications |
| University of Adelaide | **94 collaborating institutions**<br>**920 co-authored publications** | 26 collaborating institutions<br>20 co-authored publications | 24 collaborating institutions<br>17 co-authored publications |
| Monash University | **91 collaborating institutions**<br>**771 co-authored publications** | 12 collaborating institutions<br>6 co-authored publications | 15 collaborating institutions<br>22 co-authored publications |
| University of New South Wales (UNSW) | **91 collaborating institutions**<br>**521 co-authored publications** | 21 collaborating institutions<br>16 co-authored publications | 23 collaborating institutions<br>28 co-authored publications |
| James Cook University | **89 collaborating institutions**<br>**306 co-authored publications** | 35 collaborating institutions<br>48 co-authored publications | 53 collaborating institutions<br>82 co-authored publications |
| Curtin University | **83 collaborating institutions**<br>**221 co-authored publications** | 8 collaborating institutions<br>6 co-authored publications | 22 collaborating institutions<br>17 co-authored publications |
| Australian National University (ANU) | **77 collaborating institutions**<br>**425 co-authored publications** | 18 collaborating institutions<br>25 co-authored publications | 32 collaborating institutions<br>32 co-authored publications |
| Deakin University | **77 collaborating institutions**<br>**276 co-authored publications** | 2 collaborating institutions<br>4 co-authored publications | 37 collaborating institutions<br>14 co-authored publications |
| La Trobe University | **77 collaborating institutions**<br>**169 co-authored publications** | 9 collaborating institutions<br>5 co-authored publications | 39 collaborating institutions<br>16 co-authored publications |
| Queensland University of Technology (QUT) | **68 collaborating institutions**<br>**177 co-authored publications** | 9 collaborating institutions<br>5 co-authored publications | 10 collaborating institutions<br>15 co-authored publications |
| Griffith University | **68 collaborating institutions**<br>**170 co-authored publications** | 13 collaborating institutions<br>9 co-authored publications | 22 collaborating institutions<br>20 co-authored publications |
| Western Sydney University | **68 collaborating institutions**<br>**166 co-authored publications** | 16 collaborating institutions<br>8 co-authored publications | 29 collaborating institutions<br>13 co-authored publications |
| University of Tasmania | **67 collaborating institutions**<br>**156 co-authored publications** | 15 collaborating institutions<br>18 co-authored publications | 30 collaborating institutions<br>23 co-authored publications |
| Macquarie University | **65 collaborating institutions**<br>**178 co-authored publications** | 10 collaborating institutions<br>11 co-authored publications | 29 collaborating institutions<br>16 co-authored publications |
| University of Newcastle | **60 collaborating institutions**<br>**137 co-authored publications** | 6 collaborating institutions<br>5 co-authored publications | 8 collaborating institutions<br>8 co-authored publications |
| Flinders University | **59 collaborating institutions**<br>**144 co-authored publications** | 3 collaborating institutions<br>3 co-authored publications | 9 collaborating institutions<br>8 co-authored publications |
| University of Technology Sydney (UTS) | **55 collaborating institutions**<br>**148 co-authored publications** | 11 collaborating institutions<br>11 co-authored publications | 12 collaborating institutions<br>19 co-authored publications |

(Continues)

(Continuation)

| Institution | **Total** | Agriculture and veterinary sciences | Environmental sciences |
|---|---|---|---|
| Royal Melbourne Institute of Technology (RMIT) | **53 collaborating institutions**<br>**83 co-authored publications** | 8 collaborating institutions<br>7 co-authored publications | 17 collaborating institutions<br>9 co-authored publications |
| University of South Australia | **50 collaborating institutions**<br>**75 co-authored publications** | 1 collaborating institution<br>1 co-authored publication | 4 collaborating institutions<br>3 co-authored publications |
| Charles Darwin University | **48 collaborating institutions**<br>**59 co-authored publications** | 8 collaborating institutions<br>8 co-authored publications | 40 collaborating institutions<br>34 co-authored publications |
| Murdoch University | **47 collaborating institutions**<br>**58 co-authored publications** | 9 collaborating institutions<br>9 co-authored publications | 6 collaborating institutions<br>6 co-authored publications |
| University of Canberra | **45 collaborating institutions**<br>**99 co-authored publications** | 4 collaborating institutions<br>3 co-authored publications | 22 collaborating institutions<br>13 co-authored publications |
| University of Southern Queensland | **37 collaborating institutions**<br>**41 co-authored publications** | 1 collaborating institution<br>2 co-authored publications | 4 collaborating institutions<br>4 co-authored publications |
| Edith Cowan University | **36 collaborating institutions**<br>**60 co-authored publications** | 0 collaborating institutions<br>0 co-authored publications | 16 collaborating institutions<br>7 co-authored publications |
| University of New England | **36 collaborating institutions**<br>**48 co-authored publications** | 12 collaborating institutions<br>14 co-authored publications | 12 collaborating institutions<br>14 co-authored publications |
| University of Wollongong | **34 collaborating institutions**<br>**84 co-authored publications** | 10 collaborating institutions<br>8 co-authored publications | 7 collaborating institutions<br>8 co-authored publications |
| Swinburne | **33 collaborating institutions**<br>**119 co-authored publications** | 1 collaborating institution<br>2 co-authored publications | 2 collaborating institutions<br>2 co-authored publications |
| Southern Cross University | **31 collaborating institutions**<br>**45 co-authored publications** | 9 collaborating institutions<br>10 co-authored publications | 13 collaborating institutions<br>12 co-authored publications |
| Charles Sturt University | **30 collaborating institutions**<br>**119 co-authored publications** | 8 collaborating institutions<br>10 co-authored publications | 10 collaborating institutions<br>9 co-authored publications |
| Federation University Australia | **29 collaborating institutions**<br>**17 co-authored publications** | 12 collaborating institutions<br>1 co-authored publication | 3 collaborating institutions<br>2 co-authored publications |
| Australian Catholic University | **28 collaborating institutions**<br>**58 co-authored publications** | 1 collaborating institution<br>1 co-authored publication | 4 collaborating institutions<br>2 co-authored publications |
| Central Queensland University (CQU) | **10 collaborating institutions**<br>**12 co-authored publications** | 3 collaborating institutions<br>2 co-authored publications | 3 collaborating institutions<br>2 co-authored publications |
| Victoria University | **0 collaborating institutions**<br>**0 co-authored publications** | 0 collaborating institutions<br>0 co-authored publications | 0 collaborating institutions<br>0 co-authored publications |

Source: Universities Australia (2022).