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Synthetic Biology

National Progress Report

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Contents

Introduction

Synthetic biology, also known as engineering biology, combines engineering workflows and sophisticated genetic technologies to rapidly design and build novel biological solutions. This interdisciplinary area has the potential to deliver knowledge and tools that underpin new products and manufacturing approaches across a range of industries, from novel medical products to the sustainable production of food, energy, medicines, chemicals, and materials. Synthetic biology could also enable carbon emissions reduction and sequestration across these industries, accelerate the decarbonisation of the global economy and create new jobs. Portions of this report categorise the potentially impacted sectors into agriculture and food, health and medicine, environment and cleantech, and industry and energy.

In 2021, CSIRO released *A National Synthetic Biology Roadmap*.[1] The Roadmap sought to raise awareness of existing national capabilities, outline strategic growth opportunities, and provide recommendations for pursuing them. The Roadmap noted that synthetic biology would be critical to a thriving Australian bioeconomy, but greater national coordination was needed to support industrial translation, scaling, and the commercial success of its applications.

Since the release of the Roadmap, Australia has made several investments into further developing the nation's synthetic biology capabilities. This progress report highlights the evolution of Australia's synthetic biology ecosystem over the last three years, discussing major developments in research and industry, and updating the Roadmap's 2040 national market sizing analysis. This report reiterates that a prominent domestic opportunity to develop a national synthetic biology capability exists. With appropriate support and investment, this capability could underpin up to $30b in annual revenue across impacted sectors and create over 50,000 new jobs by 2040.

This progress report was informed by desktop research using publicly available information. Case studies demonstrate developments in the local market and highlight the growing potential and breadth of applications of synthetic biology in Australia. This report is not intended to be an exhaustive representation of the synthetic biology ecosystem in Australia.

Recent research and translation activities

Australia has continued to foster a strong synthetic biology research and development ecosystem, announcing $44.5m in research grants and establishing research translation and commercialisation support programs over the last three years.

Over the last three years, national research grant schemes (e.g., Australian Research Council (ARC) and National Health and Medical Research Council (NHMRC)), have awarded $29.7m in grants for discrete research projects directly related to synthetic biology (see Figure 1).[2] An additional $14.8m of grant funding was identified that supported broader biotechnology research projects and could indirectly support the development of national synthetic biology capabilities.[3] The ARC also separately funds Centres of Excellence, Training Centres and Development Hubs to undertake synthetic biology research, development and translation activities. For example, the ARC Centre of Excellence for Synthetic Biology ($35m over 7 years, awarded in 2021) (see Case study 1), and the ARC Digital Bioprocess Development Hub ($5m awarded in 2021).

Research grants awarded in 2023 saw increased funding awarded for environment and cleantech and agnostic research, the latter referring to research developments that could be translated for application across multiple sectors. In comparison, over the 2018–20 period, 85% of grants directly related to synthetic biology were awarded to agriculture and food related research.[4] The shift towards a more balanced funding allocation could be explained by the relative maturity of agriculture and food research and applications, which are increasingly being commercialised (see Figure 2), while grant funding often focuses on discovery research which is now more evenly spread across sectors as new applications are explored.

Several initiatives have also been established and expanded over the last three years to support the translation and commercialisation of synthetic biology research (see Table 3). Activities include government investment in dedicated translation and commercialisation programs, and an increase in synthetic biology specific incubators and accelerators (see Case study 2 and 3). Research translation has also been supported by strategic investments from Federal and State governments in infrastructure and collaboration programs, resulting in joint research and industry partnerships and collaborations (see Case study 4).

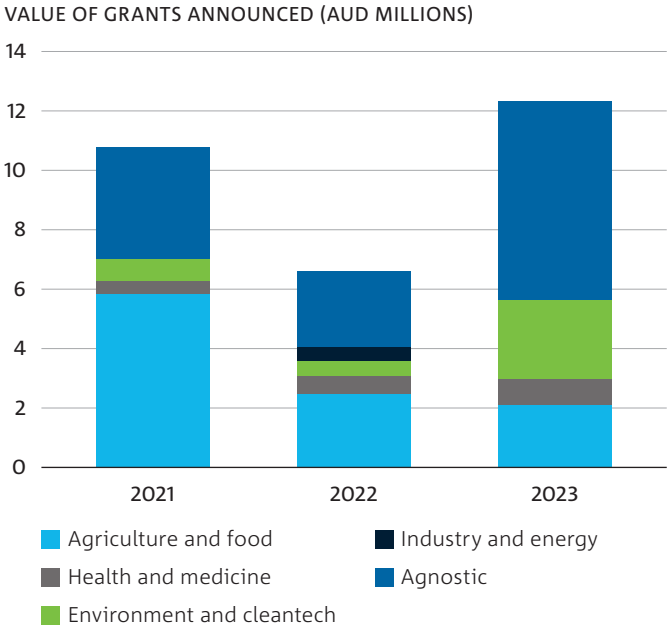


Figure 1: Research grants announced in Australia for directly related synthetic biology research, annually since 2021, by sector application.

Case study 1: ARC Centre of Excellence for Synthetic Biology

The Centre of Excellence for Synthetic Biology, led by Macquarie University, was created in 2021 with $50m in funding over 7 years from the ARC and industry and academic partners.[5] The Centre is a partnership between nine Australian universities and a range of biotech start-ups, government departments, international university and research facilities, medium to large businesses, and industry bodies. In the three years since its launch the Centre has spun out seven startup companies. Researchers at the Centre have also undertaken a range of nationally and globally significant synthetic biology research. As part of the global research collaboration Yeast 2.0 Project, which is attempting to create the first completely engineered *Saccharomyces cerevisiae* strain, researchers at the Centre have designed and built the synthetic single yeast chromosome, *SynXIV*.[6]

ARC CENTRE OF EXCELLENCE IN SYNTHETIC BIOLOGY

Case study 2: The Trailblazer Universities Program

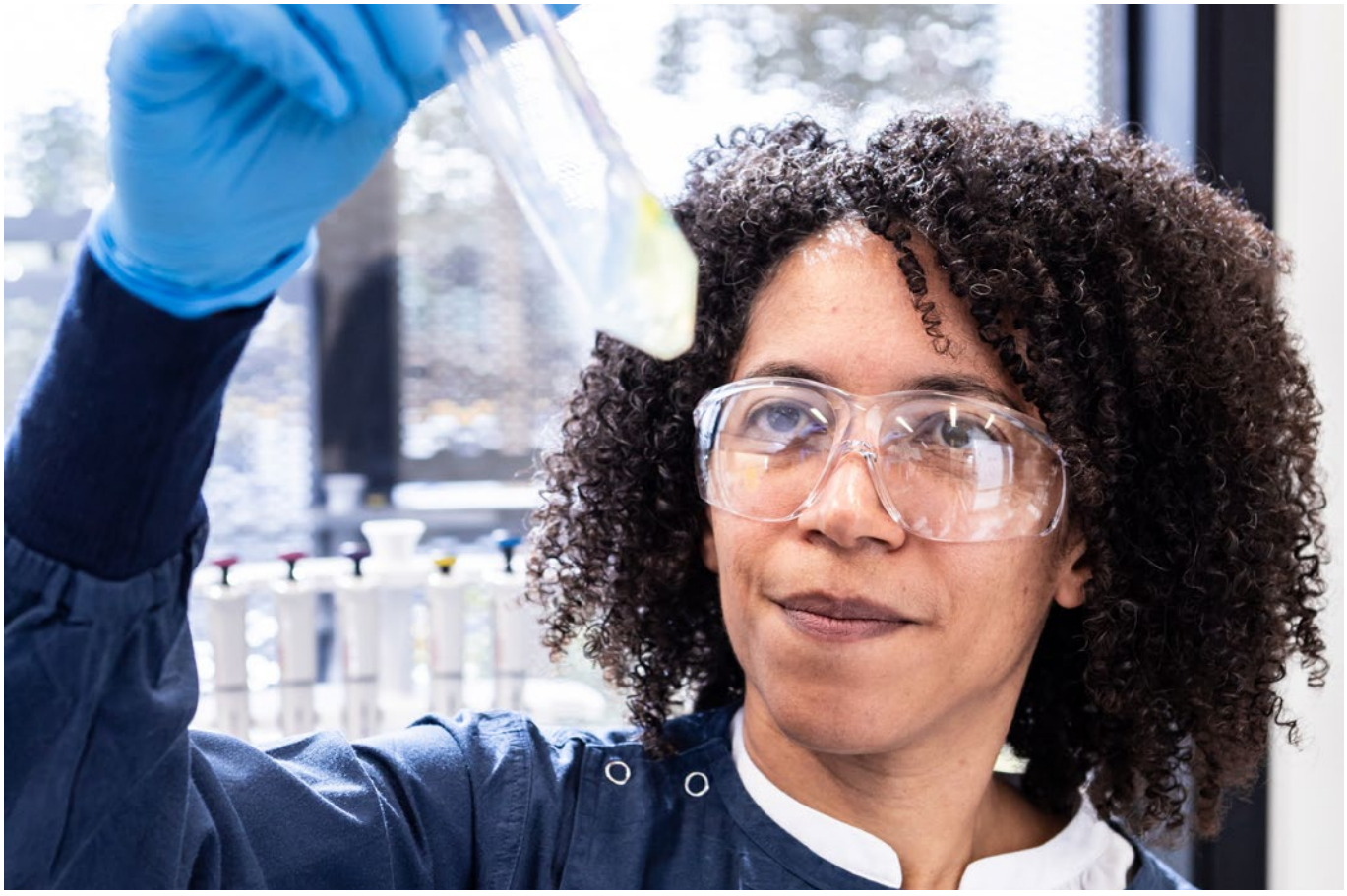
In 2022 the Australian Government Department of Education launched the Trailblazer Universities Program to build new research capabilities and drive commercialisation outcomes.[7] The program has established two synthetic biology enabled projects.

The Food and Beverage Accelerator (FaBA)[8] is a $160m initiative with $50m of Trailblazer investment led by the University of Queensland (UQ) in collaboration with partners the Queensland University of Technology (QUT), the University of Southern Queensland and UniQuest. FaBA will build new research capabilities, drive commercialisation, and invest in industry engagement opportunities for the food and beverage manufacturing sector, focusing on smart production and biomanufacturing innovations, including those underpinned by synthetic biology.

FaBA Food and Beverage Accelerator

The Recycling and Clean Energy Commercialisation Hub (REACH)[9] is a $380m initiative with $50m of Trailblazer investment, based at Deakin University's Future Economy Precinct. REACH is leading Australia's largest recycling and clean energy advanced manufacturing ecosystem and is using synthetic biology enabled technologies to convert organic waste into higher-value products.

DEAKIN UNIVERSITY REACH Recycling and Clean Energy Commercialisation Hub



Case study 3: UNSW Founders Program Bio10x

The University of New South Wales (UNSW) Founders Program created Bio10x in 2022 to address the gap between researcher ideation and startup creation and facilitation, specifically for synthetic biology.[10] The program is open to startups from across Australia and delivered in partnership between UNSW Founders, Main Sequence Ventures (MSV), UNSW RNA Institute and UNSW School for Biotechnology and Biomolecular Sciences. Each participating startup is offered $140,000 investment via a Simple Agreement for Future Equity from UNSW ($20,000) and MSV ($120,000) with potential for high performing startups to secure further MSV investment. The program also offers up to six months of free access to university facilities, services and labs at UNSW, and up to $30,000 worth of services and access to facilities across Australia through partnerships with Bioplatforms Australia (BPA) and the Australian Genome Foundry. Over two cohorts, Bio10x has supported nine companies from across Australia, and Bio10x Cohort 1 companies have already raised over $15m from local and international investors.[11]

Case study 4: IDEA Bio

The Integrated Design Environment for Advanced Biomanufacturing (IDEA Bio) at UQ was established in 2021 as one of the two Biofoundries funded by the National Collaborative Research Infrastructure Strategy (NCRIS) and BPA.[12] With a $2.2m investment from NCRIS and matching contributions from the Queensland (QLD) Government and UQ,[13] the facility specialises in deep molecular characterisation of strains within instrumented bioreactors, aiming for comprehensive cellular understanding to enhance strain design. The primary objective is to evaluate strains in a controlled environment that simulates scale-up conditions, ensuring consistent performance in both laboratory and large-scale settings. IDEA Bio collaborates with Australian and international companies and research organisations to advance the development of new processes for fuels, chemicals, and food.[14]

Recent industry activities

Australian industry continues to be strengthened by an accelerated growth in synthetic biology capabilities, attracting over $363m in capital investments in the last three years, with agriculture and food applications still representing the largest share of both Australian-founded synthetic biology start-ups and capital investments raised.

At least 16 new synthetic biology enabled companies were founded in Australia since the start of 2021, marking the continuation of accelerated growth since 2018 (see Figure 2). Most of these new companies have been spin-outs from universities and research organisations, with companies benefiting from the growing number of incubator and accelerator programs across Australia. The majority of emerging Australian companies are focused on one of the two largest global markets: agriculture and food, or health and medicine. However, there is increasing activity in the environment and cleantech sector.

Since 2021, mature start-ups have continued to scale onshore by attracting interest from local and international investors (see Case study 5, 6 and 7), with successful onshore scaling also facilitating their entry into international markets and access to international collaborations. There have also been instances of Australian companies partnering with offshore synthetic biology enabled companies to support their commercial scale-up and entry into Australia. For example, the strategic collaboration between Australian company Woodside Energy and New Zealand founded and US based synthetic biology enabled carbon capture and transformation company LanzaTech.[15]

At the same time, several mature Australian startups have relocated offshore for growth. For example, in 2022, Change Foods signed an agreement with KEZAD Group to design a commercial manufacturing plant in Abu Dhabi that would enable a greater distribution network to the Middle East and Asia Pacific region and in 2023, they transitioned their research and development hub from the QUT to Silicon Valley to get access to a larger network of research, development and technology hubs.[16] Another example is PYC Therapeutics, which relocated to the US in 2021 after identifying an active US biotechnology market where their technologies were of critical interest, and to transition operations to clinical-stage biotechnology.[17]

Substantial capital investments, including venture capital (VC), incubator and accelerator program funding, and business grants from domestic and international funders, have enabled the synthetic biology sector to consistently contribute to broader sectoral growth in Australian Industry (see Figure 3). Approximately $363m of capital funding was raised by 17 Australian-founded synthetic biology companies (31% of all active synthetic biology enabled companies) over the last three years.[18] As most Australian synthetic biology enabled companies are still in their infancy, most funding is being raised through Early-Stage VC and Seed Funding rounds. The distribution of capital funding has predominantly supported companies in the *agriculture and food* sector ($290m over the three-year period), which aligns with the larger number of Australian start-ups operating in this area.

Case study 5: Cauldron

Based in Orange, NSW, Cauldron provides bioproduction and fermentation services intended to help fermentation technology companies create sustainable food, feed, fibre, and fuel. Cauldron plans to build Asia-Pacific's largest network of precision fermentation facilities to help develop and commercially scale new products and ingredients.[19] To support this, in 2023, Cauldron raised $10.5m from local and global investors to fund the expansion of its existing pilot plant, build a national production network, and start establishing a unique and global commercial scale capability for precision fermentation. The funding round, led by MSV and Hong Kong's Horizons Ventures, was oversubscribed and one of Australia's largest seed rounds for a female-founded startup.[20] Cauldron partnered with Boston Bioprocess in 2023 to further accelerate the industrial-scale production of Cauldrons fermentation technology.[21] In 2023, Cauldron also received $500,000 from the QLD government to conduct a feasibility study for developing a $300m world-leading Future Foods BioHub facility in Mackay as part of the QLD 10-Year Biofutures Roadmap and Action Plan.[22]

Cauldron

Case study 6: HydGene Renewables

HydGene Renewables, which spun out from Macquarie University, is engineering microorganisms with synthetic biology to produce hydrogen on-site from renewable plant material and biomass waste.[23] In 2021, it was awarded $1m from the Australian Government's Business Research and Innovation Initiative to develop a proof-of-concept process to convert farm biomass waste into hydrogen. HydGene participated in the CSIRO ON Program and the AgriFutures evokeAG Startup Network program, which provided company building support ahead of its first seed investment round.[24] In 2023, HydGene raised $6m in seed funding from an international consortium led by UK biotechnology venture capital firm Agronomics, accompanied by the Australian Clean Energy Finance Corporation (CEFC), Understorey Ventures and NOAB Ventures. These funds will be used to scale up production of its biocatalyst technology and expand its team.[25]

HydGene Renewables

Case study 7: Samsara Eco

Samsara Eco aims to recycle plastic waste for three key sectors (fashion, automotive and packaging), using synthetic biology to develop enzymes that break down plastics into its components. Since its founding in 2021, Samsara Eco has continued to scale up and has attracted a range of major Australian and international companies as customers and investors, including Woolworths, Tennis Australia, Lululemon and Kanematsu.[26] In March 2022, Samsara Eco raised $6m in a funding round backed by CEFC, Woolworths Group's W23 venture capital and growth fund, and MSV.[27] In November 2022, Samsara Eco raised $54m in Series A funding which will help build Australia's first Infinite Recycling Facility and research and development Hub within the Poplars Innovation Precinct at Jerrabomberra, NSW.[28] The facility, expected to open in late 2024, will focus on accelerating Samsara Eco's research and scaling up its technology for commercialisation.

samsara eco

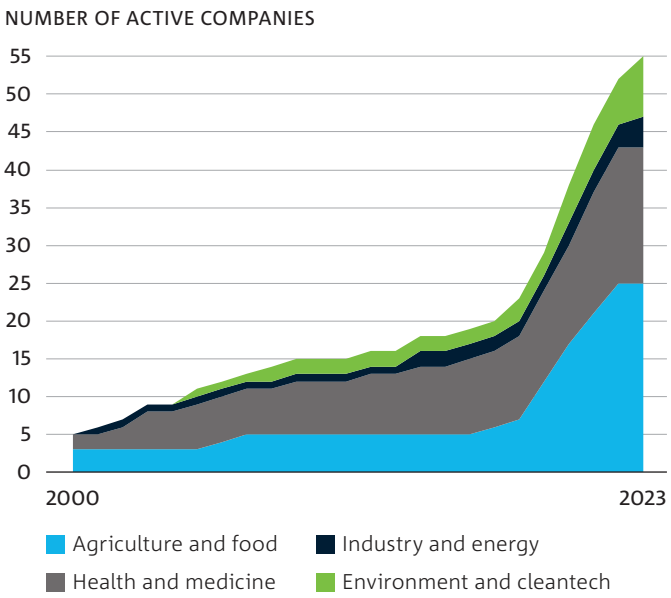


Figure 2: Active Australian-founded synthetic biology companies, over time, stacked by sector.

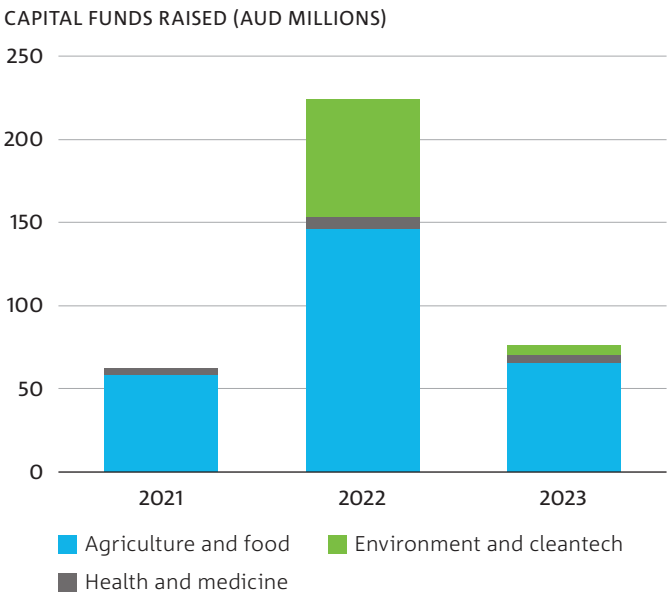


Figure 3: Capital funds raised for Australian-founded synthetic biology companies, annually since 2021, by sector.

Australia's economic opportunity

With appropriate investment and support, Australia's synthetic biology capabilities could underpin $30b of revenue annually and create over 50,000 new jobs by 2040.

This analysis provides market estimates for synthetic biology enabled revenue and jobs by the year 2040 across several Australian sectors, including agriculture and food, health and medicine, and other sectors. The latter includes applications in green technologies, industrial chemicals, energy and fuels, mining, and consumer products, which were unable to be broken down into discrete categories within this approach.

Methodology

The methodology from the 2021 Roadmap was replicated,[29] focusing on the aspirational future (high market growth, high market share scenario), and using the most recent data available. A top-down approach to market sizing was employed.

First, the global opportunity for synthetic biology by 2040 was modelled based on recent market research reports (i). The global opportunity estimate was obtained by averaging parameter estimates published across different market research reports and aligning application categories.[30] From this figure, Australia's potential share of the global market was calculated using the original Roadmap assumptions (ii). The potential headcount employment for Australia was then calculated using an assumed ratio between wages and revenue in synthetic biology-enabled industries (iii). The calculations used are as follows:

(i) Global opportunity for synthetic biology by 2040 = $A \times (1+B)^{19}$

(ii) Australia's share of the synthetic biology market by 2040 = $A \times (1+B)^{19} \times C$

(iii) Potential headcount employment for Australia by 2040 = $(A \times (1+B)^{19} \times C \times D) / E$

Table 1 displays the updated parameters used in the economic analysis.

Table 1: Updated economic analysis parameters[31]

		AGRICULTURE AND FOOD	HEALTH AND MEDICINE	OTHER	TOTAL
A	Current estimate of global synthetic biology market (2021)[32]	$1.4b	$5.8b	$4.6b	$11.8b
B	Forecast annual growth in global synthetic biology opportunity[33]	31.7%	21.6%	23.7%	24.6%
C	Market share of synthetic biology captured by Australia by 2040[34]	4.5%	3.0%	4.0%	3.9%
D	Wages as a % of revenue for biotechnology in Australia by 2040[35]				28.2%
E	Average wage for workers in biotechnology in Australia by 2040[36]				$160,775

Results

The analysis found that synthetic biology could underpin $29.6b in annual revenue and 51,950 new jobs by 2040 (see Table 2). Compared to the 2021 Roadmap estimates,[37] the total global revenue potential, national revenue potential, and national employment potential for synthetic biology have all increased. It was previously estimated that global and national revenue could reach $697.4b and $27.2b by 2040, respectively, with potential of producing 44,070 domestic jobs. This increase in results is driven by the current global market estimate (Parameter A) nearly doubling since the Roadmap.

These updated results imply a more even distribution of potential across sectors. Sensitivity analysis shows that, for all parameters, variation in the forecast annual growth rate (Parameter B) has the greatest influence on results.[38]

Agriculture and food: It was previously estimated that national revenue and employment could reach $19.3b and 31,210 jobs by 2040. Despite a reduction in expected national revenue to 12.0b and employment potential to 20,980 jobs for agriculture and food applications, this sector remains the largest and most mature synthetic biology sector for Australia, with the highest global annual growth projections (Parameter B) of the sectors. The reduction in expected national estimates is driven by a readjustment of market expectations for global growth projections to 2040 (Parameter B).

Health and medicine: The national revenue for health and medicine applications remains as previously estimated at $7.2b, and the employment potential has grown from 11,720 to 12,540 jobs by 2040.

Other applications: It was previously estimated that national revenue and employment could reach $0.7b and 1,140 jobs by 2040. The global and national revenue potential for *other* applications has increased compared to Roadmap estimates, with national revenue expected to reach 10.5b and employment potential to 18,430 jobs. This is supported by growth in local energy and cleantech focused start-ups identified in the Industry section of this report. This increase in estimates is driven by increases in global market estimates (Parameter A), forecast growth estimates (Parameter B), and domestic market share (Parameter C).

Table 2: Updated economic analysis results[39]

	AGRICULTURE AND FOOD	HEALTH AND MEDICINE	OTHER	TOTAL
(i) Potential global revenue by 2040	$265.8b	$238.4b	$262.7b	$766.9b
(ii) Potential Australian revenue by 2040	$12.0b	$7.2b	$10.5b	$29.6b
(iii) Potential Australian jobs by 2040	20,980	12,540	18,430	51,950

Roadmap recommendations: recent progress

The 2021 Roadmap put forward 10 recommendations that were designed to set the foundations for a strong synthetic biology ecosystem by 2025. Table 3 summarises key investments and activities against these recommendations that have occurred since the Roadmap's analysis.

The progress against these recommendations was rated as strong, moderate, or low. Ratings considered the collective investment amount against each recommendation as well as whether identified activities were specific to synthetic biology.

Overall, considerable progress has been made through targeted investments that support research translation, seed new businesses, and develop shared infrastructure. This has been driven by Federal and State governments. These investments have also been underpinned by shifts in policies and frameworks that include consideration of synthetic biology.

Less activity was identified for recommendations relating to attracting international businesses and enhancing international collaboration. This is also the case for efforts to strengthen foundational ecosystem enablers including leadership, governance, and skills.

Activities undertaken since 2021 that map to the Roadmap recommendations

ENABLING THEME	Support research translation and seed new businesses through targeted investments and bio-incubator programs

ROADMAP RECOMMENDATIONS

1 Prioritise translation support for applications that can most quickly demonstrate commercial feasibility

2 Establish bio-incubators to support the development of synthetic biology start-ups

RECENT ACTIVITIES

Strong: Considerable progress has been made for translational support, driven by Federal and State government programs that prioritise research commercialisation and investing in infrastructure, including:

- Australian Government – ARC Grant and Fellowship Programs (ongoing)
- Australian Government – Industry Growth Program (2023, $392m)
- Australian Government – ARC Industrial Transformation Research Program: Digital Bioprocess Development Hub (2021, $5m)
- Australian Government – Trailblazer Universities Program: Food and Beverage Accelerator (2022, $50m)
- Australian Government – Trailblazer Universities Program: Recycling and Clean Energy Commercialisation Hub (2022, $50m)
- Australian Government – NCRIS Program: Australian Genome Foundry (2021, $8.3m)
- Australian Government – NCRIS Program: Bioplatforms Australia (BPA) (2023, $55m)
- Breakthrough Victoria – Jumar Bioincubator (in collaboration with CSL Limited, the Walter and Eliza Hall Institute, and the University of Melbourne) (2023, $65m)
- NSW Government – Emerging Industry Infrastructure Fund (EIIF) for synthetic biology and biomanufacturing (2022, $6m)
- QLD Government – Biofutures Industry partnerships program (2021, $350m)
- Victorian Government – mRNA Victoria Research Activation Program (2022, $21m)
- Victorian Government – mRNA Victoria Research Acceleration Fund (2023, $25m)

Moderate: There is only one accelerator program that specifically targets synthetic biology: UNSW Founders Program Bio10x (2022). However, there is progress in the broader deep-tech space as public and private sectors have established incubators and affordable co-working and laboratory spaces for start-ups that accept synthetic biology aligned companies. Access to these initiatives is still limited, due to their size, maturity, and acceptance criteria. These programs include:

- Blackbird Foundry (2022)
- Co-Labs (2021)
- CSIRO Innovate to Grow (ongoing)
- CSIRO Kick-Start (ongoing)
- CSIRO ON Program (ongoing)
- Jumar Bioincubator (2023)
- Tadpole Bio (ongoing)
- University of Technology Sydney (UTS) Deep Green Biotech Hub Innovation Challenge (2021)

ENABLING THEME **Develop shared infrastructure to enable development and demonstration of synthetic biology applications**

ROADMAP RECOMMENDATIONS

3 Support national biofoundries to develop their scale and capability

4 Develop pilot and demonstration-scale biomanufacturing facilities certified to work with GMOs

RECENT ACTIVITIES

Strong: Further government investment into existing biofoundry facilities has supported scale and capability development across existing national biofoundries, and the establishment of a third national BioFoundry, including:

- BPA and UQ support to establish IDEA Bio at the Australian Institute for Bioengineering and Nanotechnology as a national BioFoundry (2022, $2.5m)
- CSIRO support for CSRIO BioFoundry (2022)
- NCRIS support for the Australian Genome Foundry (in partnership with BPA) to expand offerings, enable better access and support startup translational programs (2022, $8.3m)
- NSW Government EIIF support for the Australian Genome Foundry (2022, $3.5m)

Moderate: There has been an increase in the number of GMO certified biomanufacturing facilities and a scale up of processes for some applications and start-up ventures. Examples include:

- BASE mRNA facility – supported by UQ and Therapeutics Innovation Australia (NCRIS) (2021)
- Cauldron precision fermentation facilities (2023)
- Cauldron and Boston Bioprocess partnership (2023)
- QUT Mackay Renewable Biocommodities Pilot Plant (MRBPP) expansion (additional funding 2023)
- Samara Eco Infinite Recycling Facility and Research and Development Hub (2023)

ENABLING THEME **Attract international businesses and talent to build critical mass and enhance international collaboration**

ROADMAP RECOMMENDATIONS

5 Attract international businesses to establish commercial operations in Australia

6 Attract leading international researchers and strengthen international research collaborations

RECENT ACTIVITIES

Low: There have been limited outcomes in this space, despite some efforts to attract more businesses into Australia, including:

- Australian Trade and Investment Commission (Austrade) – Global Australia Initiative (2021)
- Ginkgo Bioworks expansion into Australia with support from the mRNA Victoria Research Activation Program (2022)
- LanzaTech and Woodside strategic collaboration (2022)
- Research and Development Tax Incentive (Updated 2021)
- The Translational Science Hub partnership between Sanofi, QLD Government, UQ and Griffith University (2022)

Moderate: The University sector, and some mature start-ups, have successfully recruited international talent onshore. Australia is also participating in a range of global discussions and forums that may facilitate research collaborations in time, and it has committed to activities to strengthen international collaborations, including:

- Global BioFoundry Alliance – Australian Genome Foundry, Australian Institute for Bioengineering and Nanotechnology, and CSIRO BioFoundry members (ongoing activities)
- Synthetic Biology Australasia (SBA) – SBA-SINERGY joint events (2022, 2023)
- SBA International conference (2023)
- The Yeast 2.0 Project members (ongoing activities)
- Global Future Council on the Future of Synthetic Biology membership (2021)
- Quad Critical and Emerging Technology Working Group (2021)

ENABLING THEME Strengthen foundational ecosystem enablers including leadership, governance, skills, and collaboration

ROADMAP RECOMMENDATIONS

7 Establish a national bioeconomy leadership council to advise government strategy

8 Maintain the safe and equitable governance of synthetic biology applications

RECENT ACTIVITIES

Low: Not established. However, research organisations are leading coordination and advocacy activities to build momentum and connect community with decision makers. Synthetic biology is also being incorporated into government policies and strategic plans, including:

- Australian Government Critical Technologies Policy Coordination Office – Critical Technologies Discussion Papers (Health and Agriculture) (2023)
- Australian Government Department of Education – National Innovation and Science Agenda (2022)
- Australian Government Department of Education – National Research Infrastructure Roadmap and Strategic Framework and Research Infrastructure Investment Plan (2021)
- Australian Government Department of Health – Biotechnology in Australia Strategic Plan for Health and Medicine (2022)
- Global Bioeconomy Alliance initiated by UQ and international partner universities (2021)
- NSW Government – 20-Year NSW Research and Development Roadmap (2022)
- QLD Government – QLD Biofutures 10-Year Roadmap and Action Plan (Updated 2022)

While this recommendation requires consultation to fully assess (out of scope for this report), there is some evidence of Australian governance activities, including:

- CSIRO publication of Access and Benefit-Sharing for Australian Synthetic Biologists: A Tool for Risk Management (2023)
- Australian Government Office of the Gene Technology Regulator (OGTR) ongoing activities regarding international harmonisation and regulation, and ongoing regulatory duties related to the maintenance and modernisation of legislation and governance for synthetic biology applications.

ROADMAP RECOMMENDATIONS

9 Invest in growing foundational skills across economic, digital, and social sciences alongside biophysical sciences

10 Develop and strengthen local industry-research collaborations to build capability, share knowledge, and increase employment pathways for graduates

RECENT ACTIVITIES

Moderate: Several universities have introduced courses or majors at undergraduate and postgraduate level to develop foundational synthetic biology skills, including:

- Australian National University (ANU) – ANU Synbio Challenge Team Project (Undergraduate)
- Deakin University – Synthetic Biology (Undergraduate)
- Flinders University – Bioengineering/Synthetic Biology and Human Disease Biology (Masters)
- Griffith University – Law and Synthetic Biology (Undergraduate/Masters/Juris Doctor)
- UQ – Synthetic Biology and Industrial Biotechnology (Undergraduate/Masters)
- University of Western Australia – Synthetic Biology: Solving Global Challenges (Masters)

Moderate: In addition to programs that bring together research and industry (see Recommendations 1 and 2), the government has supported collaboration through research grants and programs, including:

- ARC Centre of Excellence for Synthetic Biology (2021, $35m)
- ARC Centre of Excellence for Synthetic Biology: Find a Researcher/Expert Directory (FRED) program (2023)
- ARC Centre of Excellence for Plants for Space (2021, $35m)
- ARC Centre of Excellence for Plant Success in Nature and Agriculture (2021, $35m)
- ARC Centre of Excellence for the Mathematical Analysis of Cellular Systems (2022, $35m)
- ARC Digital Bioprocess Development Hub (2021, $5m)
- ARC Training Centre for Facilitated Advancement of Australia's Bioactives (2021, $5m)
- CSIRO Advanced Engineering Biology FSP (2022, $25m)

Call to action

The 2021 Roadmap envisioned that by 2040 synthetic biology would underpin a thriving Australian bioeconomy, creating new jobs and economic growth, enhancing competitiveness in key industries, and addressing critical environmental and health challenges. The pathway to 2040 requires building and sustaining activity for all 10 recommendations, which aim to set the foundations for a strong synthetic biology ecosystem.

While the recommendation mapping process identified strong progress against goals relating to translation support and infrastructure, less activity was identified for attracting international collaboration and talent, and strengthening synthetic biology leadership, governance, and skills. Investment across all 10 recommendations, as well as assessing the effectiveness of discrete investments over time to inform future investments, will help to ensure Australia is well positioned to capture the value outlined in the 2040 vision.

This report demonstrates that Australia is progressing well towards this future but more needs to be done. Sustained and nationally coordinated investments in synthetic biology will be critical to accelerating the commercial successes and real-world impacts of Australia's maturing bioeconomy.

Endnotes

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2 Based on RGS Grant Search, GrantConnect, and Research Data Australia search results for grants awarded for synthetic biology related projects between 2021 and 2023.

3 Based on RGS Grant Search, GrantConnect, and Research Data Australia search results for grants awarded for synthetic biology related projects between 2021 and 2023.

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Agriculture and food: average of 2021 revenue category estimates of sum of 'food and beverage' and 'agriculture' from BCC Publishing, 'agriculture' from Frost & Sullivan, and 'food and agriculture' from Technavio.

Health and medicine: average of 2021 revenue category estimates of 'healthcare' from BCC Publishing, 'smart therapeutics' from Frost & Sullivan, and 'healthcare' from Technavio.

Other: average of 2021 revenue category estimates of sum of 'research', 'industrial chemicals' and 'consumer products' from BCC Publishing, 'micro/nanotechnology', 'environment', 'biosecurity' and 'renewable energy' from Frost & Sullivan, and 'industrial' and 'other applications' from Technavio.

31 All monetary figures are presented in nominal terms, and all CAGR and wage growth estimates are assumed to include the impacts of inflation.

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Health and medicine: average of 2021 revenue category estimates of 'healthcare' from BCC Publishing, 'smart therapeutics' from Frost & Sullivan, and 'healthcare' from Technavio.

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RBA Historical Data – Exchange Rates, Series ID: FXRUSD, USD$1=AUD$1.29 from Jan 2000 – Dec 2020.

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Australia's assumed market shares of the global synthetic biology opportunity remain unchanged from the original modelling, as these were guided by an expert consultation process which was not repeated for this shorter re-estimation exercise. These market shares were assumed for 'agriculture and food', 'health and medicine' and 'total' applications, and market share for 'other' applications was then calculated based on the ratio of potential Australian revenue to potential global revenue for 'other' applications, leading to a variation from the Roadmap.

35 IBISWorld 2023, X0001 Biotechnology in Australia Industry Report.

The ratio of wages to revenue for Australian biotechnology was used as a proxy from a comparable industry to estimate the relationship between wages and revenue in synthetic biology. A ten-year average of wages as a proportion of revenue from 2020–21 to 2029–30 was calculated from IBISWorld projections.

36 IBISWorld 2023, X0001 Biotechnology in Australia Industry Report.

Average wages in Australian biotechnology are currently over $130,000, with annual wages projected to grow at a 0.9% annual average from 2020–21 to 2029–30. This wage growth rate was used to grow the average wage estimate out to 2040.

37 CSIRO Futures (2021) A National Synthetic Biology Roadmap: Identifying commercial and economic opportunities for Australia. CSIRO, Canberra.

38 Sensitivity analysis investigated how an increase or decrease in each parameter by 20%, holding all other parameters constant, changed the results.

39 All monetary figures are presented in nominal terms. Any discrepancies in summations are due to differences in rounding.

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