

Australian CBDC Pilot for Digital Finance Innovation



PROJECT REPORT
AUGUST 2023



RESERVE BANK
OF AUSTRALIA

DFCRC DIGITAL
THE FUTURE OF FINANCE FINANCE
CRC



Table of Contents

3	Executive Summary
11	Introduction
12	Pilot Set-up
16	Use Case Findings
26	Legal and Regulatory Findings
29	Technical Findings
32	Conclusion
33	Glossary
37	Appendix 1: Profiles of Use Case Pilots
43	Appendix 2: Project Contributors

Executive Summary

The payments landscape continues to evolve rapidly. This reflects significant changes in the payment preferences of households and firms, alongside innovation in underlying technologies. In this context, considerable research has been undertaken over recent years, both in Australia and other jurisdictions, into the potential role that a central bank digital currency (CBDC) could play in the payments system in the future.

CBDC refers to a new digital form of money, denominated in a national currency, that would be issued as a direct liability of the central bank. It could be designed for use by households and firms for everyday payments, which could be likened to a digital version of banknotes. It could also be designed for use by a more limited range of market participants in specialised payment and settlement systems.

While there is a significant body of existing research into the potential design and technical feasibility of CBDC, a question that has received less attention to date, particularly in countries like Australia that already have a modern and well-functioning electronic payments system, is the broader public policy rationale for a CBDC. To better understand how a CBDC might benefit the Australian financial system – and therefore the wider Australian public – the Reserve Bank of Australia (RBA) and Digital Finance Cooperative Research Centre (DFCRC) collaborated on a research project over the past year that explored use cases and business models that could be supported by the issuance of a CBDC in Australia.¹

Project design

The key focus of the project was to engage with industry to explore use cases for a CBDC. The project involved the RBA issuing a limited-scale ‘pilot’ CBDC in a ring-fenced environment to selected industry participants. These participants sought to demonstrate how a CBDC could be used to provide innovative and value-adding payment and settlement services to households and businesses. Unlike earlier projects where the CBDC was purely a proof-of-concept, the pilot CBDC was issued as a real legal claim on the RBA.

In response to a white paper published in September 2022, industry participants were invited to submit proposals of CBDC use cases.² A subset of these use cases was then selected by the RBA and DFCRC to be developed and operated by the industry participants in a live transactional environment, utilising the pilot CBDC. The benefit of exploring use cases with a pilot CBDC was that it forced the project to confront, and provide insights into, a range of issues that would be associated with issuance of a CBDC, should a decision to issue one in Australia ever be made. This included legal, regulatory, technical, and operational considerations.

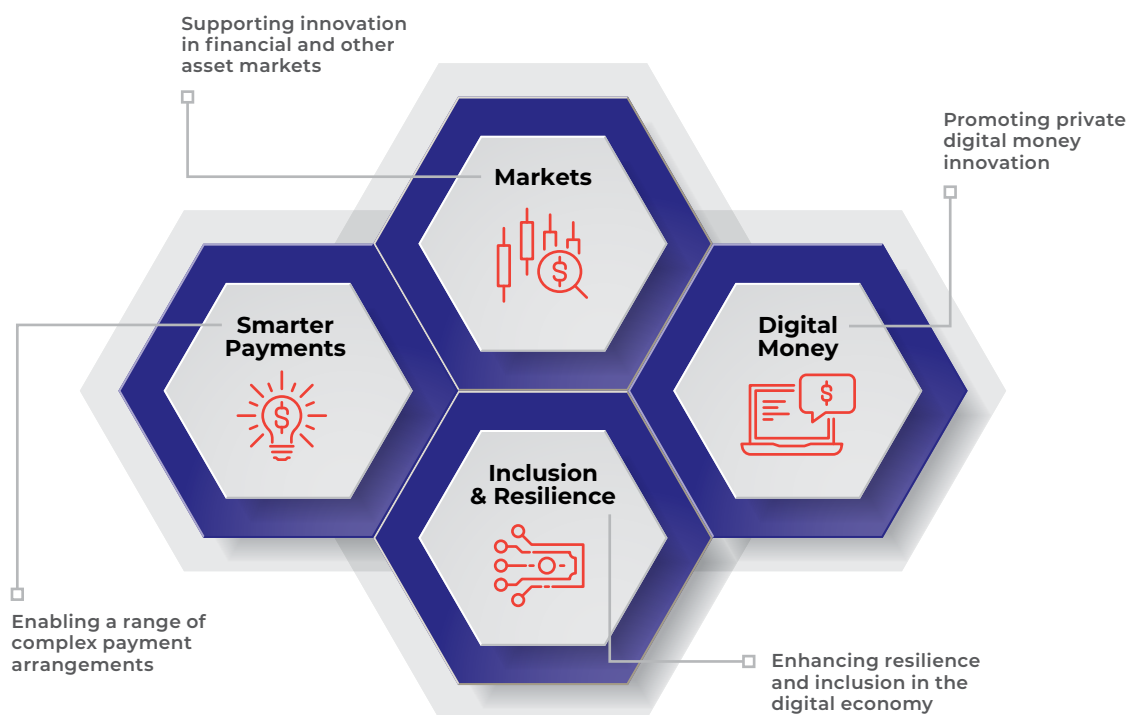
1. The Australian Treasury participated as a member of the Steering Committee for the project, along with the RBA and DFCRC.

2. See RBA and DFCRC (2022), ‘Australian CBDC Pilot for Digital Finance Innovation’, White Paper, September.

The project benefited from strong industry engagement, with around 110 use case submissions from firms seeking to participate in the transactional pilot. Based on a range of criteria considered by the RBA and DFCRC, 16 of these use cases were subsequently selected to participate in the pilot, which took place from March to July 2023. In addition, around 60 submissions were received from entities seeking to contribute their views on CBDC use cases while stopping short of participating in the transactional pilot phase of the project. Submissions were made by a range of Australian industry participants, from smaller fintechs to larger financial institutions, and often involved a consortium of entities collaborating on specific use cases. In addition to the transactional pilot, the project included an extensive industry consultation process, with more than 50 companies and government departments interviewed for their views on CBDC and potential use cases.

Use case findings

The submissions covered a wide range of CBDC use cases that could potentially deliver benefits to Australian households and businesses. Four key themes emerged:



Enabling ‘smarter’ payments. Many submissions highlighted the ability to directly control and program a tokenised CBDC as enabling a range of complex payment arrangements that are not effectively supported by existing payment systems.³ Submissions highlighted how it was possible to write code, such as smart contracts, that automatically initiate payments using a tokenised CBDC when predefined conditions are met. This can allow complex transactions, such as multi-party or multi-stage payments, to execute automatically and simultaneously, reducing the need for costly reconciliation processes and the risk of failed transactions.

3. Tokenisation refers to the process of creating digital tokens that represent ownership rights to assets, which can be traded and stored on DLT platforms. See the Glossary.



Supporting innovation in financial and other asset markets. There was significant interest from industry participants in exploring the tokenisation of financial and other (real) assets on distributed ledger technology (DLT) platforms, with CBDC being used in the ‘atomic’ settlement of transactions.⁴ This included traditional debt securities markets, where settlement times are typically measured in days. Several different types of less liquid assets were also tokenised in the transactional pilot, including Australian carbon credit units, NSW biodiversity credits, and supplier invoices, with atomic settlement effected in pilot CBDC. Participants noted that the tokenisation of assets on DLT platforms had the potential to deliver a number of benefits including improving the efficiency, transparency, liquidity, and accessibility of asset markets.



Promoting private digital money innovation. Submissions highlighted the role that a CBDC could potentially play in promoting interoperability and uniformity of new forms of private digital money, such as tokenised bank deposits and stablecoins backed by high-quality assets. In this role, CBDC could serve a similar function to settlement balances held at the central bank for settling payments made using commercial bank money. A number of submissions also highlighted the potential for privately issued stablecoins that were fully backed by CBDC to more readily compete with digital forms of money issued by regulated financial institutions.



Enhancing resilience and inclusion in the digital economy. Some submissions explored the possibility that CBDC could improve the resilience of the payments system by providing households and businesses with an alternative way to make payments in certain scenarios. This included the ability to make offline electronic payments in scenarios where electricity and/or telecommunication services were not available, for instance following natural disasters. Others suggested that access to a digital form of money that does not rely on having a commercial bank account could offer social benefits to certain groups in the community who may encounter difficulties using conventional banking services, such as travellers, foreign students, and victims of domestic violence.

CBDC capabilities and features

Submissions highlighted a number of specific features and capabilities of a CBDC that would be valued in industry use cases:

- **Claim on the central bank** – as a direct claim on the central bank, a CBDC would provide a guaranteed form of value and eliminate counterparty risk when used as a medium of exchange. The ability to settle transactions directly in central bank money, or in privately issued digital money like stablecoins that are fully backed by CBDC, was valued in a number of use cases. This was particularly the case in the settlement of high-value transactions, such as financial assets and property, where the risks associated with settlement in traditional commercial bank money were perceived to be greater.

4. Atomic settlement refers to a process where settlement occurs in an integrated fashion, such that it is technologically infeasible for one leg of a transaction to occur without the other. Traditionally, these legs occur in separate systems and although they may be designed to occur simultaneously, they may occur at slightly different times due to separation between each system. See the Glossary.

- **Direct control** – the pilot CBDC was issued as a digital token on a DLT platform where the holder was able to directly control the pilot CBDC without relying on an intermediary unlike transactions that use a traditional bank account. For example, transferring the pilot CBDC could be performed directly by the holder. Some participants noted this feature could provide greater flexibility and control over how a CBDC (and digital money more broadly) was used and reduce reliance on intermediaries.
- **Programmability** – many use cases highlighted benefits arising from the ability to write smart contracts (or other code) whereby holders can program how a tokenised CBDC is used. This included stipulating predefined conditions upon which a payment in CBDC was automatically executed. The ability to program payments using a CBDC could improve efficiency and reduce risk in a range of complex business processes, in ways that may be difficult to achieve using intermediated payment systems.
- **Atomic settlement** – many submissions pointed to the benefits of a tokenised CBDC allowing for atomic settlement of transactions in tokenised assets. Many noted that this process has the potential to reduce settlement risk and improve the efficiency of settlement processes, though it was also noted that other risks, such as operational and liquidity risks, would require careful management.
- **Transparency** – some use cases highlighted the potential benefits of transparency of CBDC balances and transactions, which is a feature of some DLT platforms. This feature could allow end users to independently verify CBDC balances, for example, where CBDC is used as a risk-free asset to support the issuance of a stablecoin. However, transparency was not a universally valued feature; some participants noted that transaction privacy was necessary to support a variety of banking and other financial use cases.

A CBDC (like settlement account balances at the RBA) would represent a direct claim on the central bank. This is a key distinguishing feature from other forms of private digital money. However, it is possible that many of the benefits linked to the pilot CBDC in use case submissions could be achieved in other ways, including through privately issued forms of digital money such as tokenised bank deposits or asset-backed stablecoins. In other words, in a number of use case submissions, it was not clear that CBDC was exclusively required to achieve the desired economic outcomes. Some combination of other forms of private digital money, wider access to RBA settlement account balances and enhancements to existing payments infrastructure, may have also yielded improvements over current practices. There is considerable scope for further research in this regard.

Legal and regulatory findings

Given that the pilot CBDC was structured as a real claim on the RBA and that the use cases involved actual customers, participants in the transactional pilot were required to demonstrate that they met all relevant legal and regulatory requirements prior to operating their use cases. ASIC and AUSTRAC supported this process, including the assessment of the regulatory status of the use cases. Given the ring-fenced and research-based nature of the project, several regulatory exemptions were provided by ASIC and AUSTRAC to facilitate the operation of the use cases and thereby contribute to the research findings from the project.

The process of assessing the regulatory status of the piloted use cases highlighted uncertainties relating to how CBDC and new business models utilising it could fit into current legal and regulatory frameworks. Some uncertainties related to the bespoke nature of the pilot CBDC itself. For instance, the pilot CBDC was issued as a contractual liability of the RBA rather than under a legislative framework, as would likely be the case if a decision was ever made to issue a CBDC in the future.

Other uncertainties related to the regulatory status of some pilot CBDC use cases under the current regulatory framework. For example, there were several use cases that used pilot CBDC in the settlement of transactions in tokenised digital assets. In many instances, there was uncertainty around the legal and regulatory treatment of the digital assets, in particular whether they were regulated 'financial products' under the *Corporations Act 2001*. This had implications for the regulatory status of the use cases.

More broadly, the project underscored the potential for new business models enabled by CBDC to emerge in the future. Given the unique characteristics of a CBDC-enabled system relative to existing payment and settlement mechanisms, new business models could change the nature of risks involved in performing regulated financial services. This could in turn invite a reassessment of the appropriate regulatory treatment. For example, a number of use cases highlighted the potential for CBDC to be used for the atomic settlement of transactions in tokenised asset markets, excluding the need for a centralised intermediary. The nature of risks in this type of arrangement could be quite different to those in traditional clearing and settlement (CS) facilities. This raises questions about whether the existing licensing and regulatory framework for CS facilities under the *Corporations Act* would be well calibrated to the risks associated with new business models facilitating atomic settlement of transactions in tokenised asset markets.

Some of the legal and regulatory issues highlighted by the project are being addressed through ongoing policy work led by the Treasury. For example, the Treasury's recent consultation on 'token mapping' examined how various digital assets fit within existing legal and regulatory frameworks.⁵ The Government is also developing a regulatory regime for crypto-asset service providers and is in the process of reforming the payments regulatory architecture in Australia, including modernising the *Payment Systems (Regulation) Act 1998* and introducing a new payments licensing framework.

More generally, the findings from this project suggest several promising avenues for future research into the legal and regulatory implications of CBDC issuance. This includes work to deepen understanding of the legal implications of issuing a CBDC, and of enhancements that may be required to existing regulatory frameworks to allow responsible service providers with new business models and use cases to innovate under appropriate regulatory oversight.

5. See *The Australian Government the Treasury (2023), 'Token Mapping', Consultation paper, February.*

Technical findings

It was not an objective of this project to evaluate the technology that would be best suited to implementing a CBDC. Nonetheless, certain technology decisions were required to stand up the pilot CBDC platform. The project chose an Ethereum-based DLT implementation for the pilot CBDC platform. This provided a customisable and open technology that is widely used for digital asset innovation. The platform facilitated participation by entities using both traditional and DLT-based technologies and provided a minimum set of capabilities required to facilitate testing of use cases. The choice of technology for the platform did not reflect a presumption that a CBDC would be DLT-based (should one ever be issued in the future) or that Ethereum would necessarily be an appropriate choice for a production system.

Noting that technology was not a key focus of the project, there were a number of technical findings relating to the design of the pilot CBDC platform and how it integrated with use case platforms that may be relevant for future research:

- In order to reduce technical complexity, risk and regulatory ambiguities, the project did not allow the deployment of 'smart contracts' or other code directly on the pilot CBDC platform. This prevented industry participants from creating asset tokens on the pilot CBDC platform and from deploying smart contracts that would have enabled conditional or multi-party payment settlement directly on the pilot CBDC platform. Instead, industry participants were able to implement conditional or multi-party payments via smart contracts deployed on their own use case platforms, though this complicated the implementation of some use cases.
- Atomic settlement is most easily achieved by having both tokenised money and assets on the same ledger. Many of the pilot use cases utilised a 'wrapped' CBDC – a type of stablecoin fully backed by pilot CBDC – that was issued on the use case platforms. The wrapped CBDC was then able to be used to conduct atomic settlement with tokenised assets held on the same platform, though it also introduced additional complexity and risk.
- The approaches taken by industry participants to facilitate the atomic settlement of tokenised assets and to implement programmable payments using pilot CBDC highlighted the need to carefully consider the deployment model for a CBDC. For example, further research could explore the implications of allowing industry smart contracts to be deployed onto a CBDC platform or allowing CBDC to be issued directly onto industry platforms.
- Most industry participants preferred that pilot CBDC balances and transactions were private, while a few valued the benefits of transparency that came from the DLT implementation (e.g. to allow independent verification of financial capacity or reserve backing of stablecoins). The design decisions required to effectively support the variety of needs for privacy and data sharing are challenging, and the technologies to implement those requirements on a single CBDC platform are also complex, warranting further research.
- Given the technical design of the pilot CBDC platform was not a primary focus of the project, further work would also be required to understand how different technical implementations could address non-functional requirements that are likely to be important for a CBDC, such as scalability, security, and resilience.

Conclusions

Overall, this research project has helped to advance understanding of a number of issues related to the potential issuance of a CBDC in Australia, including by:

- yielding valuable insights into how a CBDC could be used by industry to enhance the functioning of the payments system
- highlighting a range of legal, regulatory, technical and operational issues associated with CBDC that need to be better understood
- providing a forum for increased industry engagement and information exchange with policymakers, including relating to the challenges and opportunities in further enhancing the operation of the payments system using new forms of digital money
- identifying a range of areas for future research into the future of money in Australia.

The results from the project indicated that a CBDC has the potential to support increased efficiency and resilience in some areas of the payments system, though more research is required. The use cases examined in the project suggested that broad access to a CBDC could support (directly and indirectly) the creation of new or more efficient markets. Supply chain and business processes could also be enhanced. There was particular interest from industry in exploring how the development of tokenised asset markets could be facilitated by the introduction of a CBDC. Submissions illustrated how a CBDC could be used in a variety of ways – including by facilitating atomic settlement, programmable payments and increased transparency and resilience in offline environments – that could help to unlock benefits for the economy as a growing share of activity occurs in the digital domain. Equally, some participants in the project noted that a CBDC could facilitate the development of new forms of privately-issued payment instruments and infrastructure, including stablecoins that are fully backed by CBDC. In this sense, a CBDC could be viewed more as an enabling complement to, rather than substitute for, private sector innovation.

At the same time, the project raised a number of questions and revealed various legal, regulatory, technical and operational issues that warrant further consideration as part of future research on CBDC in Australia. For example, the project highlighted the need for more analysis of the legal underpinnings of a CBDC, including the legal basis on which one could be issued and its legal status. Similarly, given a CBDC could give rise to new types of business models and change the nature of some risks in the financial system, further consideration may need to be given to whether (and if so, how) existing regulatory frameworks would require adjustment. While the technical design of the pilot CBDC platform was not a key focus, the experience highlighted potential challenges associated with the integration of use case applications with a CBDC platform. This included ensuring the efficiency and integrity of atomic settlements and programmability across networks. Further analysis would also be needed to validate the business and technical design features of a CBDC so it could deliver on the identified capabilities. Key non-functional characteristics that were not a focus of this project – such as performance, scalability and security – would also need to be considered as part of a wider research agenda.

It is important to recognise the limits in the scope of this project and its place in the broader sweep of CBDC-related research that has been underway for a number of years in Australia and elsewhere. The project did not set out to offer a full assessment of the costs, benefits, risks and other implications of a CBDC in Australia, but rather was more narrowly focused on exploring how a CBDC could be used by industry to enhance the functioning of the payments system.⁶ Many of the issues identified in the project and in earlier research will require a program of research that is likely to unfold over a number of years. Considering the broader context – where the Australian payments system is currently meeting most of the needs of end users and work on CBDC in advanced economies is generally still in an exploratory stage – it is likely that any serious policy consideration of issuing a CBDC in Australia is still some years away.⁷

Finally, the project sponsors would like to extend their appreciation to the many industry participants who invested considerable time and resources in the project. From the outset, the project generated (and benefited from) significant industry interest, and the lessons distilled from this exercise were enriched by the active engagement of our industry participants.

6. For a recent discussion of these broader considerations, see B Jones (2022), *'The Economics of a Central Bank Digital Currency in Australia'*, Speech at 17th Central Bank Conference on the Microstructure of Financial Markets, December 8, Sydney.

7. The Government's Strategic Plan for the Payments System published in June 2023 indicated support for the Treasury and RBA continuing to explore the policy rationale for a CBDC in Australia. As part of this, the Treasury and RBA are planning to release a paper in mid-2024 that takes stock of the work to date on CBDC and outlines a forward workplan on CBDC in the broader context of the future of digital money in Australia. See The Australian Government the Treasury (2023), *'A Strategic Plan for Australia's Payments System'*, June.

Introduction

The growing share of commercial activity that is conducted digitally has prompted researchers and policymakers to better understand how new forms of digital money could better serve the needs of households and businesses. As part of this effort, considerable research has been undertaken over recent years, both in Australia and other jurisdictions, into the design and technical feasibility of CBDC, including the potential use of new technologies, such as DLT. However, a question that has received less attention to date, particularly in countries like Australia that have relatively modern and well-functioning electronic payment systems, is the broader public policy rationale for CBDC.

In 2022–2023, the RBA and the DFCRC collaborated on a research project that focused on better understanding the types of use cases and other issues that could emerge in the event that a CBDC were ever issued. The project was guided by the following research questions:

01. What, if any, are the emerging business models and use cases that a CBDC would support, that are not effectively supported by existing payments and settlement infrastructures in Australia?
02. What might be the potential economic benefits of issuing a CBDC in Australia?
03. What operational, technology, policy and regulatory issues might need to be addressed in the operation of a CBDC in Australia?

The project involved developing a limited-scale ‘pilot’ CBDC that was issued in a ring-fenced operating environment for a short period of time. Selected industry participants were able to access the pilot CBDC to demonstrate how it could be used to provide innovative and value-adding payment and settlement services to Australian households and businesses.

A novel feature of this project compared to much of the existing research on CBDC was that the pilot CBDC was structured as a real legal claim on the RBA rather than as a proof-of-concept. This approach enabled industry participants to test their use cases in a more realistic environment, involving real transactions and customers. A benefit of it being a ‘real money’ pilot is that it forced the project to confront a range of issues that would be associated with issuance of a CBDC, such as legal, regulatory, technical and operational considerations, that might not have been addressed in a proof-of-concept project.

The project was overseen by a steering committee comprising senior officials from the RBA, DFCRC and Australian Treasury, and with an independent chair (see Appendix 2).

About the DFCRC

The DFCRC is a 10-year, \$180 million research program funded by industry partners, universities and the Australian Government, through the Cooperative Research Centres Program. The DFCRC’s mission is to bring together stakeholders in the finance industry, academia and regulatory sectors to develop and harness the opportunities arising from the next transformation of financial markets – the digitisation of assets that can be traded and exchanged directly and in real-time on digital platforms. The RBA is an industry partner of the DFCRC, and is using its involvement to support its research on CBDC.

Pilot Set-up

Industry engagement

The RBA and DFCRC published a white paper in September 2022 that set out the objectives and approach of the project and invited industry participants to make submissions of CBDC use cases.⁸ The project imposed only a small set of constraints on the types of use cases that could be submitted. The main constraint was that all end users needed to be Australian-registered entities or Australian resident individuals; this excluded cross-border use cases involving foreign entities or individuals.⁹

The project benefited from significant interest and engagement from industry, with around 110 use case submissions from entities seeking to participate in the transactional pilot. In addition, around 60 submissions were received from entities seeking to contribute their views on CBDC use cases but not participate in the transactional pilot. The submissions came from a wide range of industry participants, from small fintechs to large financial institutions.

Sixteen of the use cases were selected by the RBA and DFCRC to participate in the pilot based on a number of considerations, including: the merit of the use case in leveraging the capabilities of the pilot CBDC; the potential economic or social impact of the use case; and the ability of the industry participant to meet any regulatory obligations and operate the use case within the project timeframes.

Alongside the transactional pilot, the project included an extensive industry consultation process. Given only a limited number of use cases were able to be piloted, the aim of this process was to analyse the much larger and broader variety of use cases that did not make it into the transactional pilot or were submitted for research purposes only. More than 50 companies and government departments were interviewed as part of this process.

Project ecosystem

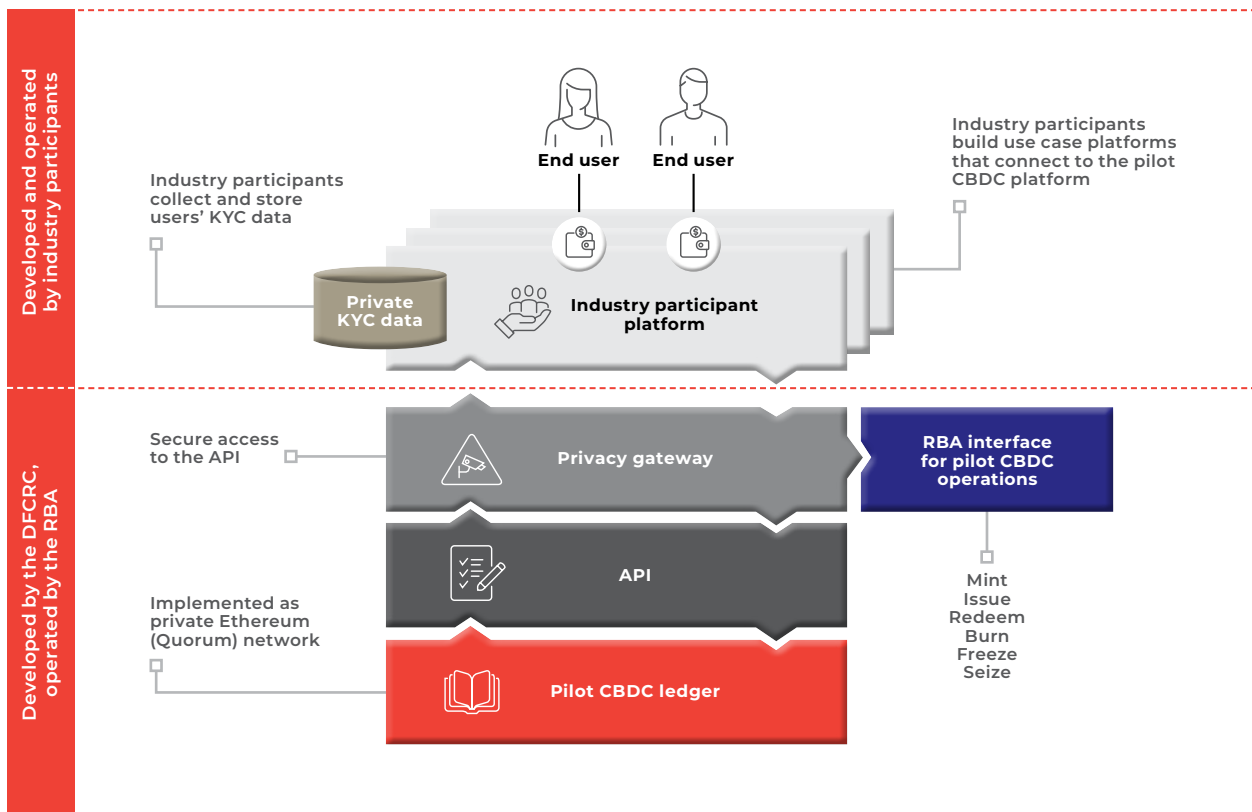
It was not an objective of the project to evaluate the technology best suited to operating a CBDC. The technological design of the pilot CBDC platform was therefore not a key focus of the project. Nonetheless, certain technology choices needed to be made in order to stand up the platform. The pilot CBDC platform was deployed as a private, permissioned DLT platform based on Ethereum (Quorum). The platform was designed to support the issuance and transactional operation of the pilot CBDC, with industry participants able to interact with the platform via application programming interfaces (APIs).

The choice of technology to implement the pilot CBDC platform did not reflect a view that any future CBDC (should one be issued) would be DLT-based or that Ethereum would necessarily be an appropriate choice for a production system. Rather, it was chosen on the basis that it provided a customisable and open standard platform based on technology that is well understood and widely used for digital asset innovation. Figure 1 illustrates the pilot ecosystem implemented by the project.

8. See RBA and DFCRC (2022), 'Australian CBDC Pilot for Digital Finance Innovation', White Paper, September.

9. This decision was made to reduce some of the risks in the project, in particular those associated with AML/CTF, though it is worth noting there was significant interest from industry participants in the potential for CBDC to enhance cross-border payments

FIGURE 1: Project Ecosystem



Other key features were as follows:

- The pilot CBDC platform did not support the deployment of smart contracts or other code by industry participants. This was to simplify the implementation of the platform and, given the real money nature of the pilot CBDC, avoid the operational liability and potential regulatory implications that might be attributable to the RBA.
- The pilot CBDC was not able to be directly issued on, or transferred to, any third-party private or public platforms. This was again to simplify implementation and to reduce risks.
- Network access to the pilot CBDC platform was limited to approved industry participants and their authorised end users to restrict usage and reduce risks. The pilot CBDC platform provided a pseudonymous level of privacy in respect of pilot CBDC balances and transactions, similar to many public DLT platforms.¹⁰ This was considered adequate given that privacy arrangements were not a research focus of the project and given the restricted access to the platform.
- The identity of end users was held by each industry participant, with no identity information stored on the pilot CBDC platform; identity management was not a research focus of the project.
- The pilot CBDC platform provided a hash time locked contract (HTLC) mechanism to enable the exchange of assets for value across different networks via an escrow mechanism (see the Glossary).

¹⁰. Individual holdings of pilot CBDC on the platform were only associated with a blockchain address, which is a random alphanumeric string that contains no personal information. The identity information linked to each blockchain address was held off-ledger by the relevant entity that verified the identity of the holder.

The RBA operated the pilot CBDC platform, including minting, issuing, redeeming and burning the pilot CBDC, and also had the ability to pause or shut down the platform if required. It also had the ability to freeze and seize pilot CBDC holdings of any participant in the project if required for operational or compliance purposes.

Industry participants were responsible for the design, development and operation of their own technical platforms to implement their use cases. This included the selection and management of 'custodial' wallet software where applicable. The pilot CBDC platform was agnostic to the technologies and networks that participants used to interact with it. As a result, industry participants implemented their use cases using a range of technologies, including traditional and DLT platforms. The vast majority of the piloted use cases were deployed on DLT platforms. This is consistent with the widespread use of DLT platforms in digital asset innovation – in part due to their native support for tokenisation and the availability of commonly used public networks, such as Ethereum, that support smart contract functionality.

The pilot CBDC platform supported three different models for the custody of pilot CBDC with the intention of supporting a wide range of use cases. The first model enabled direct control and ownership of pilot CBDC by end users via 'non-custodial' wallets. The second provided for indirect control and beneficial ownership of pilot CBDC by end users in custodial wallets provided by industry participants. The third model provided for indirect control and pooled ownership (with other end users) of pilot CBDC by end users in custodial wallets provided by industry participants.

The pilot CBDC

The pilot CBDC was issued as a real legal claim on the RBA. This was achieved through a contractual arrangement (a Deed Poll) under which the RBA had an obligation to redeem the pilot CBDC from holders for Australian dollars at par (i.e. 1-for-1) at the end of the project.

Other features of the pilot CBDC were as follows:

- It was denominated in Australian dollars, with one cent the smallest denomination.
- No interest was paid by the RBA on holdings of pilot CBDC.
- Only Australian-registered entities and Australian resident individuals were permitted to hold the pilot CBDC.
- All holders of pilot CBDC were required to undergo prescribed know your customer (KYC) verification and customer due diligence (CDD) checks through an approved industry participant. This was implemented through a 'KYC attestation' recorded on the pilot CBDC platform, which indicated that an address was eligible to receive pilot CBDC.

The project used a two-tier model for issuing pilot CBDC. The RBA issued the pilot CBDC directly to industry participants that already held an exchange settlement account (ESA) at the RBA. For participants that did not hold an ESA, wholesale distribution of pilot CBDC was facilitated by an authorised pilot CBDC distributor (see Box A). Industry participants were responsible for distributing pilot CBDC to their end users and buying it back from them at the end of the project.

Over the course of the project, the RBA issued close to \$550,000 in pilot CBDC. At the conclusion of the project, all of the pilot CBDC was redeemed and the pilot CBDC platform has subsequently been shut down.



BOX A

CASE STUDY – Wholesale distribution of pilot CBDC (ANZ Bank)

For industry participants that did not hold an ESA, wholesale distribution of pilot CBDC was facilitated by ANZ Bank, which was contracted to purchase pilot CBDC from the RBA for on-selling to industry participants selected for the transactional pilot. This involved ANZ undertaking KYC/CDD on industry participants (including KYC attestation of their address on the pilot CBDC platform) and exchanging pilot CBDC with industry participants for Australian dollars. ANZ implemented a web portal that allowed industry participants to request pilot CBDC by depositing Australian dollars into a nominated ANZ bank account. ANZ then transferred pilot CBDC into the buyer's address on the pilot CBDC platform. ANZ then bought back pilot CBDC and redeemed it with the RBA at the conclusion of the project.

Use Case Findings

This section summarises the key findings from the project relating to how a CBDC could potentially be used and the features and capabilities of a CBDC that were most valued by industry participants. The assessment is based on analysis of the use cases that were submitted and those that were piloted, as well as consultation with a wide range of participants in research interviews with the DFCRC.

Key themes from use case submissions

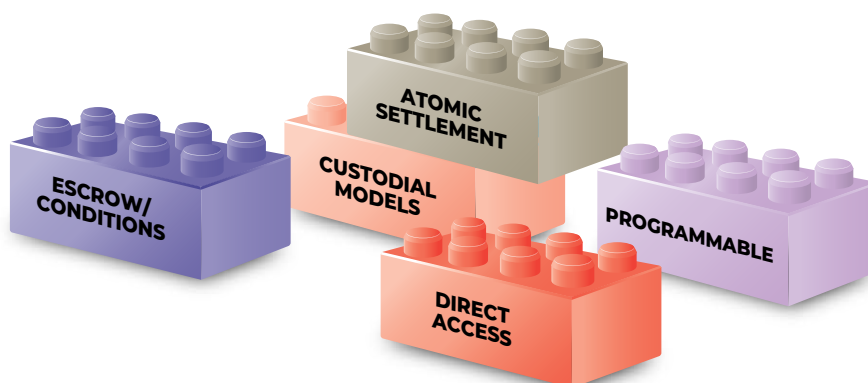
The submissions covered a wide range of use cases that issuance of a CBDC could potentially support, with four key themes emerging:

Enabling 'smarter' payments

Many submissions highlighted the ability to directly control and 'program' a tokenised CBDC as enabling a range of complex payment arrangements that are not effectively supported by existing payment systems. For example, submissions highlighted the ability to write code, such as smart contracts, that automatically initiated payments using the pilot CBDC when predefined conditions were met (so-called conditional payments). Complex transactions involving payments to multiple parties were programmed in such a way that all legs of the transaction were settled simultaneously when conditions were met. Submissions noted that this can reduce the risk of errors and failed transactions, and remove the need for costly reconciliation and manual processing.

Some submissions also noted that the ability to combine business logic with CBDC could enable new business models or improve the delivery of government programs where participants are required to comply with requirements on the use of benefits. For example, one submission proposed the use of CBDC for disbursement of benefits under the National Disability Insurance Scheme. Other examples from use cases that were piloted included automated GST collection/crediting (see Box B), employer superannuation payment disbursement and supply chain invoice financing (see Box C).

Some submissions also highlighted the potential for a programmable CBDC to provide additional functionality in various retail payment applications, such as automating the payment of utility bills and rental payments, micropayments, time-based streaming payments and even wage payments. One submission suggested that programming the use of CBDC to pay 'certified' merchants (i.e. those with a good history) could reduce payment costs by allowing consumers to opt out of certain protections, such as chargeback rights (a feature of many debit and credit cards).



**BOX B****CASE STUDY – GST automation (Commonwealth Bank/Intuit)**

This pilot use case demonstrated the collection and payment of GST using automated programmable payments implemented via the pilot CBDC. Merchants initiated the process via an in-app invoice payment request. The GST amount on the invoice was automatically calculated and paid in pilot CBDC to a holding account to be paid to the ATO, with the remainder automatically (and simultaneously) paid to the merchant. The use case illustrated the potential for programmable CBDC to increase the speed and efficiency of GST collections and to reduce the compliance burden on businesses. The feasibility of extending the use case to automate claiming of GST credits was also examined. By fully automating the calculation and payment of GST, the use case suggested a programmable CBDC could reduce the need for businesses to lodge quarterly Business Activity Statements.

**BOX C****CASE STUDY – Tokenised invoices (Unizon/Zerocap)**

This pilot use case demonstrated the issuance, third-party sale and eventual payment of a tokenised invoice between a wholesale car dealer (supplier), a third-party financier, and a wholesale car buyer (buyer). The supplier generated a tokenised invoice that represented a claim on the buyer. To optimise the supplier's working capital, the tokenised invoice was split, and a portion was sold to the third-party financier. When the invoice came due for payment, the buyer used a stablecoin backed by pilot CBDC to pay the invoice, with the payments automatically calculated and forwarded simultaneously to the supplier and financier. The use case demonstrated how issuing and paying invoices on a DLT platform could improve the transparency and efficiency of supply chain finance, which has traditionally been a paper-intensive market and one not subjected to strong competition. The submission noted that the ability to automate multi-party payments using pilot CBDC has the potential to reduce errors and counterparty risk.

**Supporting innovation in asset markets**

There was significant interest from industry participants in the tokenisation of financial and other assets. Many submissions highlighted the potential benefits for the economy from asset tokenisation as well as the potential for CBDC to be used for atomic settlement of transactions involving tokenised assets. Industry participants noted that asset tokenisation had the potential to improve efficiency and reduce risks associated with issuing, managing and trading assets in tokenised form on DLT-based platforms. It could also allow for greater fractionalisation of assets, which could broaden investor participation (including among retail investors) and increase market liquidity.¹¹

Several different types of assets were tokenised in the transactional pilot, including Australian carbon credit units, NSW biodiversity credits, debt securities (see Box D), and supplier invoices (see Box C), with settlement of transactions occurring in pilot CBDC.

11. This assumes that liquidity does not fragment across tokenised and traditional marketplaces.

Interviews with industry participants suggested that the tokenisation of assets was likely to gather pace in Australia and globally in the years ahead. Emerging asset classes (such as carbon credits), where supporting market infrastructure and processes were less established, were considered most likely to be at the forefront of this development. While participants noted that some traditional asset classes (such as bonds and mortgages) could also benefit from tokenisation – particularly where trading, clearing and settlement practices were less transparent and/or less timely – it was generally considered that evolution here would be slower given systems and market customs were already well established.

The use of non-custodial holdings of pilot CBDC enabled peer-to-peer trading of tokenised assets, changing the role of the intermediary to matching bids and offers and orchestrating a trade rather than taking custody of funds or acting as a central counterparty (see Box D). Industry participants suggested that this model could lead to efficiencies and increase participation in markets. This in turn could enable new tokenised markets to be established more seamlessly and reach a scale that would confer economic benefits.

Even in existing financial and real asset markets, such as those for securities and property where settlement in central bank money is already utilised to reduce counterparty risks, industry noted that CBDC could offer new capabilities. For instance, in the event that a central counterparty could readily access investors' CBDC holdings, they could potentially reduce (or eliminate) the need for brokers to fund margin for unsettled client transactions (see Box E).



BOX D

CASE STUDY – Tokenised securities trading (Imperium Markets)

Some wholesale markets, such as for the trading of high-quality liquid assets, operate without a centralised clearing and settlement function and require participants to settle trades through other systems with significant reconciliation overheads and counterparty risks. This pilot use case enabled two banks to be matched for the trade of tokenised debt securities, with settlement occurring in pilot CBDC under an atomic settlement model. Imperium Markets carried out delivery versus payment (DvP) settlement of the tokenised debt securities, using the 'allowance' functionality on the pilot CBDC platform (akin to a one-time direct debit authority for a specific amount) granted by the end users. Imperium Markets did not have to take custody of pilot CBDC for the settlement of transactions, which meant the end users did not take on counterparty risk to Imperium Markets.



BOX E

CASE STUDY – Cash equity clearing (Australian Securities Exchange)

This use case, which was not taken to pilot, was proposed to enable funds in the form of pilot CBDC to be held and 'locked' in the CHES accounts of equity investors at the time a trade is executed. This could provide a range of benefits including: reducing (or eliminating) margin for unsettled transactions (as the ASX could lock the pre-funded cash leg); providing early settlement optionality; lowering barriers for new brokers (by reducing brokers' dependence on their balance sheet to fund margin obligations); and providing greater investor protections (as client funds are held against an individual investor's CHES account, rather than pooled with other investor's funds as in conventional client money arrangements).



Promoting private digital money innovation

A number of submissions highlighted the role that a CBDC could potentially play in promoting interoperability and uniformity of new forms of private digital money, such as tokenised bank deposits and regulated stablecoins. In this role, CBDC could serve a similar function to settlement balances held at the central bank for settling payments made using commercial bank money.

For example, one of the use case submissions proposed the development of a shared DLT-based platform, known as a 'Regulated Liabilities Network' (RLN), on which the central bank, commercial banks and other regulated financial institutions could issue, exchange and settle their tokenised liabilities.¹² The purported benefits of an RLN are that it would maintain a two-tier monetary system in a tokenised environment, where the CBDC is used as the wholesale settlement asset that ensures the tokenised liabilities of participating financial institutions remain fungible and exchangeable at par. This could promote interoperability and uniformity in tokenised private money, while leveraging the benefits of tokenised platforms in terms of atomic settlement, programmability and 24x7x365 operation.

A number of submissions highlighted the potential for CBDC to be used as a low-risk and liquid backing asset for privately issued stablecoins (see Box F). While a CBDC-backed stablecoin would not constitute a liability of the central bank, depending on how it was structured, it could inherit much of the safety of central bank money and thus be more attractive to end users than a stablecoin backed by other assets. A CBDC-backed stablecoin could also compete more readily with tokenised liabilities issued by regulated financial institutions such as banks. Rather than competing with private digital currencies, a CBDC could be used as a tool to promote competition, innovation and safety in private digital money.

The concept of a wrapped CBDC also generated interest among industry participants, where CBDC is able to be 'locked' on the CBDC platform and then effectively re-issued on a third-party platform, such as a public network. Wrapped CBDC is seen as a way of leveraging the benefits of a CBDC in different third-party platforms, where it could, for example, be programmed or used in the atomic settlement of tokenised assets that reside on those platforms.



BOX F

CASE STUDY – Stablecoin proof of reserve (Novatti)

This use case demonstrated the use of pilot CBDC as a risk-free asset to support the issuance of a stablecoin on a public DLT platform. The issuer 'escrowed' pilot CBDC in a HTLC to guarantee that the stablecoin was fully backed. End users were able to independently verify the value of the stablecoin on issue did not exceed the value of pilot CBDC held in the HTLC. The stablecoin was issued with restrictions to ensure it could only be used by end users approved to participate in the use case.

¹² The RLN concept has been tested in a recent proof-of-concept project facilitated by the New York Innovation Centre. See Federal Reserve Bank of New York (2023), 'Facilitating Wholesale Digital Asset Settlement'.



Enhancing resilience and inclusion in the digital economy

A number of submissions suggested CBDC could improve the resilience of the payments system by providing households and businesses with an alternative way to make electronic payments. Some submissions argued that this could enable end users to engage in the digital economy without the need to use a bank account – similar to a digital version of physical cash – and potentially provide a greater level of privacy than current electronic payment methods.

Several use cases proposed technology solutions that could enable ‘offline’ electronic payments using CBDC in scenarios where a merchant has lost electricity and/or telecommunication services (e.g. in natural disasters or in communities that lack reliable online connections) (see Box G). One submission proposed the use of offline ATMs to dispense cash, triggered by end users using a card or mobile phone as the device holding CBDC; this could enable cash distribution in emergencies for immediate use without any special requirements on merchants to accept a new means of payment.

Other submissions suggested that access to a digital form of money that does not rely on having a commercial bank account could offer social benefits to certain groups in the community who may encounter challenges using commercial banking services. For example, a CBDC could be used by travellers or foreign students who may not have access to a domestic bank account, or by victims of domestic violence who may need an alternative way to make payments.



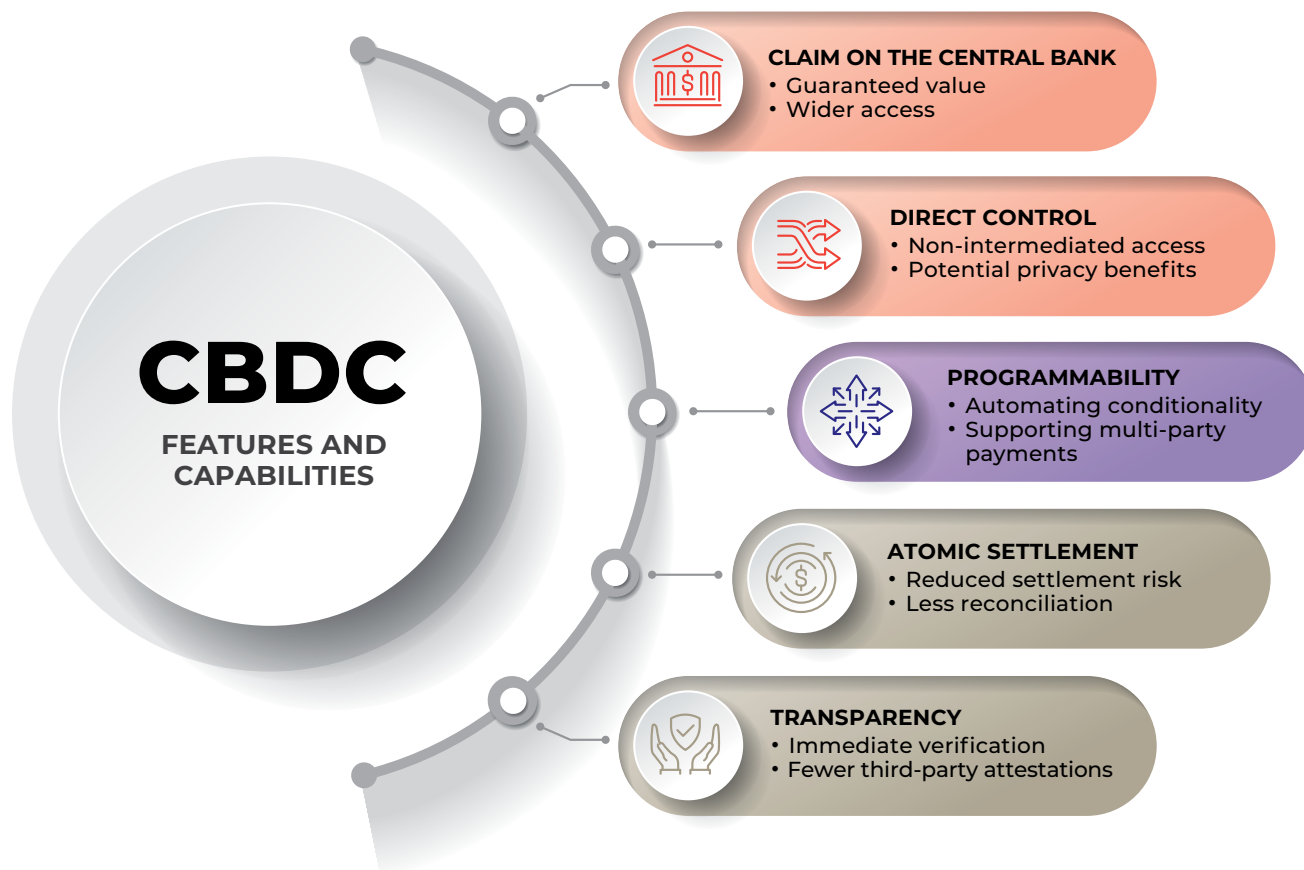
BOX G

CASE STUDY – Offline payments (ANZ Bank)

This use case demonstrated customer-to-merchant transactions in an offline environment using NFC-enabled smart cards and pilot CBDC. Two universities, RMIT University and Southern Cross University, participated with students making purchases at on-campus merchants. Merchants accepted pilot CBDC payments via secure apps installed on NFC-enabled devices, while remaining offline. The pilot CBDC smart card enabled a cash-like transfer of value using a familiar form factor.

CBDC features and capabilities

The use cases submitted by industry participants provided insights into the potential features and capabilities of a CBDC that could support new and emerging business models. Several of the capabilities could also be offered by other forms of tokenised value, such as tokenised bank deposits or asset-backed stablecoins.



Claim on the central bank

As a liability of the central bank, a CBDC would be free of credit and liquidity risk. This contrasts with other forms of money, such as commercial bank deposits, which carry the credit risk of the issuer and can introduce a degree of liquidity risk (including in times of stress).¹³

Many submissions observed that central bank money would be the preferred medium of exchange in their use case, particularly where unregulated stablecoins were the only existing medium of exchange to facilitate trade in tokenised assets. The benefits from providing a form of value free of credit and liquidity risk were noted to be most stark in use cases involving the settlement of high-value transactions, such as financial assets and property. Many of these transactions are already settled in central bank money (via the RBA's RTGS system) to reduce credit and liquidity risks; in some cases, these transactions are required to settle in central bank money to mitigate financial stability risks.

¹³ In Australia, deposits at authorised deposit-taking institutions (ADIs) are subject to depositor preference and covered up to \$250,000 per account holder per ADI by the Australian Government's Financial Claims Scheme.

Other use cases were less clear on the need for digital central bank money and their desired outcomes may have been achievable using other digital forms of money, such as tokenised commercial bank deposits or well-regulated stablecoins.

Many submissions noted the potential for CBDC to expand access to central bank money to entities that may not be eligible to hold an ESA at the RBA. This could promote competition and innovation in the payments system by allowing a wider range of entities to provide payment and settlement services using digital money that was free of credit and liquidity risk (see Box H).

Several industry participants in the transactional pilot issued their own private stablecoin backed one-for-one by pilot CBDC. In these cases, pilot CBDC was used as a risk-free asset to support the credibility of a stablecoin issued on another platform, where the stablecoin was then able to be programmed directly by a smart contract or other code to achieve the desired business benefits.

A number of submissions and industry interviews also noted the potential for pilot CBDC to enable settlement between regulated stablecoins or tokenised bank deposits, similar to the wholesale settlement function provided by ESA balances in the context of commercial bank money. This could promote the use of regulated stablecoins as a medium of exchange by ensuring that the benefits from the 'singleness' of money underpinning the modern economy are realised in the emerging tokenised economy.



BOX H

CASE STUDY – Cross-border settlement and custody (Monoova)

This pilot use case demonstrated the use of pilot CBDC to settle the domestic leg of an inbound cross-border payment. An Australian-domiciled wholesale client of the service provider sold foreign currency in exchange for AUD. Upon agreement of an FX rate and receipt of the relevant amount of foreign currency from the client, the service provider's platform settled the AUD leg by transferring pilot CBDC into the client's custodial wallet. The use case demonstrated the benefits of faster settlement of a cross-border transaction, outside Australian business hours, and reduced counterparty risk for the client. The use case also highlighted the possibility of reduced regulatory burden on the service provider since they did not need to take custody of client funds.

Direct control

The pilot CBDC was made available as a digital token on the pilot CBDC platform that was able to be directly controlled using hold, release and transfer functions without the use of an intermediary.¹⁴

To support a variety of business models, the project offered three different structures for holding pilot CBDC, with varying levels of control and ownership by end users (see Figure 2):

- **Model 1** was a 'non-custodial' (or 'self-custodial') structure, where the pilot CBDC was a direct liability of the RBA to the end user, where the end user alone had access to and transactional control of their holding via their private key.

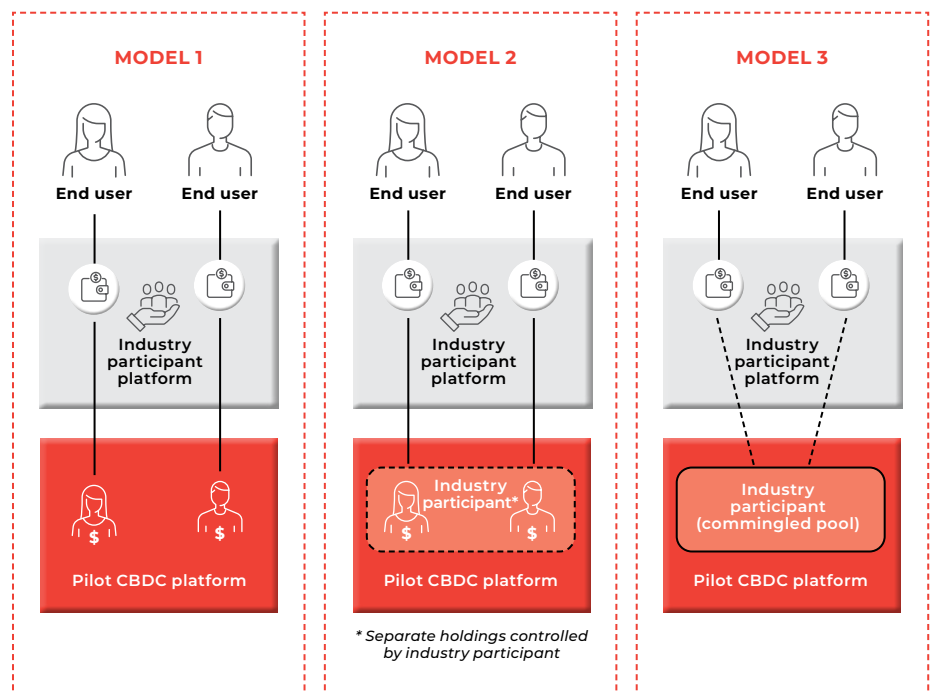
¹⁴. With traditional account-based forms of money, such as commercial bank deposits, the holder has to instruct the account provider (i.e. the bank) to perform actions such as making a transfer, which can create additional friction and may be difficult to confirm whether the transfer has completed.

- **Model 2** was a 'custodial' structure, where the pilot CBDC was a direct liability of the RBA to an end user, represented by an individual holding on the pilot CBDC ledger, but where an intermediary (the industry participant) had control of the end user's holding via control of the private key.
- **Model 3** was a 'pooled' structure, where the pilot CBDC was a direct liability of the RBA to the industry participant, who held a commingled pool of pilot CBDC on behalf of its end users. End users only had an indirect claim to the pilot CBDC, via the industry participant.

Some submissions suggested Model 1 could support inclusion of individuals in the digital economy, notably for those who are underbanked or have been de-banked. These submissions also noted the potential for direct control of pilot CBDC to enable individuals to transact privately without sharing data with financial institutions. The use case pilot for tokenised securities trading used this non-custodial model as well (see Box D). Other submissions noted Model 2 could improve transparency and mitigate some of the risks posed by financial services providers when holding client money using conventional client money arrangements (see Box I). Model 3 was typically utilised in use cases where pilot CBDC was used as a risk-free asset to support the issuance of a stablecoin.

FIGURE 2: Pilot CBDC Holding Structures

- **Model 1:** Direct liability of RBA to end user, with individual holdings on CBDC ledger controlled by end users.
- **Model 2:** Direct liability of RBA to end user, with individual holdings on CBDC ledger controlled by the industry participant on behalf of the end user.
- **Model 3:** Direct liability of RBA to the industry participant, who holds a commingled pool of CBDC on behalf of end users. End users have an indirect claim on the CBDC.





The digi.cash use case explored use of pilot CBDC for peer to peer payments, with pilot CBDC held in custody using different models. In the first, end users held pilot CBDC in an allocated address with digi.cash responsible for administering and updating pilot CBDC holdings. In the second, digi.cash used pilot CBDC to support the issuance of digital banknotes. These 'banknotes', which were issued in \$5, \$10, \$20, \$50 and \$100 denominations, were comprised of pilot CBDC held in addresses representing each individual banknote. When a banknote was transferred from one end user to another, ownership of the address corresponding to that banknote was transferred to the payee. Issuing the digital banknotes in fixed denominations enabled digi.cash to implement a privacy preserving protocol where it had limited visibility of end user balances and transactions.

Programmability

Many submissions noted the potential for programmability of CBDC to improve the efficiency of business processes through the automation of complex payment arrangements. This included conditional payments, in which the conditions for a transfer can be programmed into a digital token, as well as multi-party payments, which could benefit from the ability to execute all related transfers in a business transaction at the same time.

The pilot CBDC platform did not allow direct programming of the pilot CBDC on the pilot CBDC platform. Participants in the transactional pilot implemented their own platforms that utilised the APIs on the pilot CBDC platform to instruct the transfer of pilot CBDC and execute other functionality.¹⁵ Many industry participants indicated that they would have preferred to deploy smart contracts directly on the pilot CBDC platform to simplify the implementation of their use cases and reduce risks.

Atomic settlement

Many submissions highlighted the benefits from atomic settlement of tokenised asset transactions and observed that this can be challenging to implement with current payment and settlement systems. Atomic settlement refers to a process by which it is technologically infeasible for one leg of a transaction to occur without the other.¹⁶

When an asset is a digital token, atomic settlement is most easily achieved by having both the asset token and a form of tokenised value (e.g. CBDC) on the same platform so that they can be simultaneously exchanged. As noted earlier, the project did not permit use case participants to deploy asset tokens or other smart contracts directly on the pilot CBDC platform. Those that did participate in the transactional pilot typically used a private stablecoin backed by pilot CBDC to enable atomic settlement on another platform. This approach was used to demonstrate some of the benefits of

15. This included the HTLC functionality, which provided a form of escrow without the involvement of a third party, and the 'allowance' functionality, which enabled authorised third parties to initiate payments.

16. Traditionally, these legs occur in separate systems – a securities settlement system and a payments system – and although they may be designed to occur simultaneously, they may well have delays or occur at different times due to separation between each system.

atomic settlement, such as faster settlement, reduced settlement risk and less time spent on reconciliation. Several submissions observed that it would have been preferable to have the pilot CBDC on the same platform as the tokenised assets given that issuing a CBDC-backed stablecoin merely to facilitate atomic settlement would add complexity and risk.

Transparency

A number of submissions highlighted the transparency provided by DLT platforms as an important consideration in the design of a CBDC. Access to the pilot CBDC platform was limited to approved participants in the transactional pilot as well as their end users. End users were able to query the pilot CBDC platform using APIs (similar to a public DLT platform) to independently verify the information held on the platform. This functionality was valued in a number of the piloted use cases, such as a construction supply chain use case where a builder was able to independently verify that a customer had sufficient funds before starting work on a project.

Another industry participant provided its end users with the ability to independently verify that its private stablecoin was fully backed by pilot CBDC, without relying on a third party. Such backing could increase the acceptability of private stablecoins, especially those issued by non-bank entities, and thereby enhance competition in the stablecoin market. Such 'transparency by design' could reduce the cost of third-party attestations and improve the integrity of regulatory supervision. However, it should be noted that not all submissions valued transparency of the pilot CBDC ledger; some observed that a wide range of use cases would need a CBDC to support privacy of both balances and transactions, particularly financial sector use cases.

Legal and Regulatory Findings

A distinguishing feature of this project compared to previous CBDC research at the RBA was that the pilot CBDC was structured as a real legal claim on the RBA rather than a proof-of-concept.¹⁷ Part of the motivation for testing use cases with a pilot CBDC was that it forced the project to confront some of the legal and regulatory issues that would arise if a decision was ever taken to issue a CBDC.

Given the use cases involved pilot CBDC and real customers, participants in the transactional pilot needed to demonstrate that their use cases met all relevant legal and regulatory requirements. The most notable requirements were those relating to the provision of products and services in the *Corporations Act 2001* and the *Australian Securities and Investments Commission Act 2001* (both administered by ASIC), and those dealing with financial crime prevention in the *Anti-Money Laundering and Counter-Terrorism Financing Act 2006* (AML/CTF Act; administered by AUSTRAC). ASIC and AUSTRAC were closely engaged in this aspect of the project, including in the review of the regulatory status of the use cases.

While there were benefits in structuring the project as a real money pilot, this approach also created challenges because it was not possible within the scope of the project to establish a comprehensive legal and regulatory framework for pilot CBDC. The pilot CBDC was instead issued under a bespoke legal arrangement as a contractual liability of the RBA.¹⁸ Several constraints were built into the project aimed at limiting the risks associated with the issuance and use of the pilot CBDC. These included caps on the amounts of pilot CBDC that were made available to use cases, and a short time horizon over which the pilot CBDC could be used.

To help limit the regulatory burden associated with participating in the pilot, participants were invited to discuss with the relevant regulators the possibility of formal exemptions from regulatory obligations arising from their participation in the project. Ultimately, and subject to certain conditions, AUSTRAC issued an exemption from relevant AML/CTF Act obligations that covered all the industry participants. ASIC issued pilot-specific exemptions to some industry participants who did not otherwise have the appropriate regulatory authorisations or where obligations would have been onerous given the scope of the project. In providing regulatory relief, both agencies took a pragmatic approach, taking into account the limited scope and research-based nature of the project.

The process of assessing the regulatory requirements applicable to the use cases and providing regulatory exemptions highlighted several findings that can inform further work into the legal and regulatory underpinnings for a CBDC.

Legal status of CBDC

Since the pilot CBDC was a novel instrument, there was uncertainty about its legal status and regulatory treatment. Some participants were uncertain if they were providing custody services or dealing in a regulated financial product because of holding or dealing in the pilot CBDC. These issues would ideally be anticipated and resolved in any legal and regulatory reforms that accompany the issuance of a CBDC.

17. Earlier CBDC projects, such as Project Atom in 2020–2021, involved the development of a proof-of-concept CBDC, where the CBDC was not real money in the sense of being a legal claim on the RBA.

18. Specifically, the RBA issued a Deed Poll in favour of all holders of pilot CBDC under which the RBA committed to redeeming all holdings of pilot CBDC for Australian dollars.

Regulatory status of use cases

Many industry participants also found it difficult to understand how the relevant regulatory regime might apply to their use case (as opposed to the pilot CBDC itself). For example, there were several use cases that involved the use of pilot CBDC for settlement of transactions in various types of digital assets, such as stablecoins or tokenised financial or non-financial assets. In many of these use cases, there was uncertainty around the legal and regulatory treatment of the digital assets, in particular whether they were regulated ‘financial products’ under the *Corporations Act 2001*, which had implications for the regulatory status of the use case.

Some industry participants deployed smart contracts to automate certain processes or services supported by the pilot CBDC. In one use case, since the smart contract was deployed by an identifiable party related to the use case, the regulatory responsibility for the operation of the smart contract was relatively clear (see Box C). But this issue also highlighted questions about how regulatory responsibility could be allocated if the entity deploying the smart contract could not be identified, such as in emerging decentralised finance (DeFi) applications.

There was also uncertainty about the AML/CTF Act regulated services that were involved in many of the use cases. In many instances, this question could turn on whether the pilot CBDC was technically characterised as ‘money’ or another type of asset, and whether the technology providing access to the pilot CBDC (e.g. wallet software) could be characterised as a virtual ‘stored-value card’, an ‘account’, or something else. While there is no question that services involving a CBDC (should one be issued) should be subject to the AML/CTF Act, the nature of regulatory obligations and when they arise would ultimately depend on how the CBDC and related services are characterised in the supporting legal framework.

More broadly, by underscoring the potential for new CBDC-enabled business models to emerge in the future, the project raised questions about whether existing regulatory requirements would remain appropriate for entities offering regulated products and services supported by CBDC. Some of the business models explored in the project could change the nature of risks involved in performing regulated financial services and may therefore warrant consideration of different regulatory treatments.

A notable example here relates to the use cases that demonstrated the potential for CBDC to be used for the atomic settlement of transactions directly between buyers and sellers in tokenised asset markets (see Box D). Depending on how settlement is achieved, these types of arrangements could change the nature of risks compared to traditional clearing and settlement (CS) facilities. This raises questions about whether certain obligations in the existing licensing and regulatory framework for CS facilities under the *Corporations Act* would be appropriate for the risks associated with business models facilitating atomic settlement of transactions between customers in tokenised asset markets.

Work to address some of the legal and regulatory issues highlighted in the project is underway, with the Treasury’s recently published *Token Mapping* consultation paper representing the Government’s first step towards examining how a range of digital assets fit within existing laws and regulations.¹⁹ The Treasury is also currently consulting on introduction of a payments services licensing regime, including for payment stablecoins, and will be consulting with industry participants on licensing and custody obligations for crypto-asset service providers.²⁰

The findings from this project, alongside other policy work on CBDC, should help to inform future analysis of the legal implications of issuing a CBDC, and regulatory enhancements that may be considered to enable responsible entities with new business models to operate with appropriate regulatory oversight.

19. See *The Australian Government the Treasury (2023), ‘Token Mapping’, Consultation paper, February.*

20. See *The Australian Government the Treasury (2023), ‘Payments System Modernisation (Licensing: Defining Payment Functions)’, Consultation paper, June.*

Facilitating industry innovation through regulatory sandboxes

Regulators are generally restricted in their ability to provide regulatory relief based on the laws they administer and can only exercise their delegated powers to provide exemptions in certain circumstances. For this project, the focus on testing the pilot CBDC and use cases in a realistic setting resulted in the industry participants and regulators dedicating significant time and resources to determining how the existing regulatory framework would apply and, where relevant, providing pilot-specific regulatory exemptions.

Given the nature of the current legal and regulatory framework, similar efforts would likely be required in any future projects of a similar nature, even in cases where the testing is conducted in heavily controlled environments. To facilitate future industry experimentation and testing of new financial products and services, the use of a regulatory sandbox could be considered. A fit-for-purpose sandbox would ensure the availability of a safe testing environment for new projects without significant regulatory obstacles, while minimising consumer harm.

Currently, ASIC administers an 'enhanced regulatory sandbox' (ERS) on behalf of the Government that allows unlicensed entities to test some types of financial services without an Australian financial services licence for a limited period and subject to certain conditions.²¹ None of the use cases in the pilot project utilised the ERS. Instead, for the types of services able to be tested in the ERS, ASIC provided bespoke relief to some unlicensed entities, while larger licensed entities are not eligible for the ERS.

Given the challenges experienced by some industry participants in achieving regulatory compliance in this project, there may be scope to consider how Australia's regulatory sandbox arrangements could be calibrated in the future. For example, consideration could be given to arrangements that facilitate regulatory relief on a project-wide basis, subject to appropriate controls, including providing access to entities that may already be licensed in some areas. Such arrangements could play an important role in fostering broad industry participation in innovation projects in the future. The experience of other jurisdictions in operating regulatory sandboxes to promote innovation could offer useful lessons in this regard.

21. See ASIC (2023), '[Enhanced regulatory sandbox](#)'.

Technical Findings

As noted earlier, the technical design of the pilot CBDC platform was not a key focus of the project. The pilot CBDC platform was developed as a private, permissioned Ethereum (Quorum) network, which is a form of DLT.²² However, this choice of technology does not reflect any view by the RBA that a CBDC would be DLT-based, should one ever be issued.

To support the project's objectives, the key non-functional requirements in the design of the pilot CBDC platform were for ease of interoperability and integrity of pilot CBDC balances and transactions. There were no non-functional requirements relating to transaction speed, scalability, and long-term maintainability, for example.

The following findings arise from observations relating to the design, implementation, and operation of the pilot CBDC platform and the associated use case ecosystem. In particular, the way participants interacted with the stand-alone pilot CBDC platform provided several insights on potential deployment models for a CBDC.

Programmability

As discussed previously, the pilot CBDC platform did not allow user programmability of pilot CBDC, nor the deployment of smart contracts or other code by industry participants on the platform. This was achieved by the use of a firewall that blocked the deployment of smart contracts. This constraint significantly reduced technical risk from possible defects or 'bugs' in users' smart contracts that might have controlled pilot CBDC tokens, and consequently reduced legal and regulatory risks in the project. This constraint also removed the need to perform resource accounting and resource management for the execution of industry participants' programs.²³ The only form of programmability available in the project was through the ERC-20 token standard, which could be incorporated into external programmable systems through an API in a way that could automate the initiation of pilot CBDC transactions and other allowed functions.

Settlement

For direct use of CBDC for payment, the pilot platform provided a HTLC mechanism to facilitate peer-to-peer settlement. HTLCs let parties achieve peer-to-peer settlement where the money and assets exist on different ledgers but are more complex than settlement where both are on the same ledger. For example, using HTLCs, a settlement failure can arise if one of the parties closes out their side of the settlement process before the HTLC times out. Services that automate the completion of settlement could help to mitigate this risk, without needing control over the assets.

Although the platform provided HTLCs to support settlement between pilot CBDC and assets on different ledgers, no industry participants used this in the pilot. Some industry participants noted that they were able to achieve settlement of assets and tokenised value on their use case platforms using already existing smart contracts and that this approach was preferable to redesigning their use case platforms to use the HTLC mechanism. Some industry participants noted integration requirements and potential for vulnerabilities as other reasons for not using the HTLC mechanism.

22. The Ethereum implementation was provided by Kaleido as a cloud-based managed service. Enterprise key management for secure minting, issuance and redemption of pilot CBDC by the RBA was implemented via a managed service provided by Fireblocks.

23. 'Gas' or other transaction fees are often paid for smart contract execution on blockchain platforms, in large part to compensate for and limit excessive resource utilisation. However, these fees were not payable for pilot CBDC transactions in the project.

Deployment models

The ways in which industry participants interacted with the pilot CBDC platform, in particular to facilitate atomic settlement of tokenised assets and implement programmable payments using pilot CBDC, suggests merit in exploring the costs and benefits of different deployment models for a CBDC.

- One possible model is a standalone CBDC platform operated by the central bank, which is separated from industry platforms via a security layer. This is the model explored in the project. A benefit of this model is that it is easier to control who can access the CBDC platform and it keeps risks associated with industry use cases separate from the CBDC ledger. However, as experienced in this project, the separation between the CBDC and industry use case platforms creates challenges for how industry participants interact with the CBDC. For example, achieving atomic settlement across platforms is technically challenging. Cross-network 'bridges' in DLT networks are not yet robust but viable solutions could emerge in the future. Issuing wrapped CBDC as a way to facilitate atomic settlement across platforms can also introduce additional risks and complexity.
- Another option would be a shared CBDC platform onto which industry smart contracts or other code could be deployed. This model would allow participants to directly program how a CBDC was used, which could simplify atomic settlement and more tightly couple business and payment processes. However, this approach could significantly increase burdens in relation to platform availability, security and performance and introduce risks associated with malicious or faulty smart contract code. The requirement to review and approve industry smart contracts would introduce additional cost and complexity.
- Another option could be for the central bank to issue CBDC directly onto multiple third-party platforms (e.g. private, permissioned networks or even public DLT platforms) alongside tokenised assets issued by industry participants. This approach could potentially offer the most flexibility in how a CBDC is used, but it would introduce significant additional burdens in terms of assessing the suitability of different platforms for CBDC issuance, especially in relation to security, scalability, privacy and regulatory compliance. One use case demonstrated how controls could be applied to wrapped pilot CBDC issued on a public DLT platform (see Box J).

There is scope for further research on CBDC deployment models to assess the implications and technical requirements to balance risks with the opportunities for industry innovation.



BOX J

CASE STUDY – Interoperable CBDC for Web3 commerce (Mastercard/Cuscal)

This pilot use case demonstrated the purchase of a non-fungible token (NFT) listed on the Ethereum public blockchain using a wrapped pilot CBDC token. The process locked an amount of pilot CBDC on the pilot CBDC platform and issued an equivalent amount of wrapped CBDC on the public Ethereum network. The buyer then used the wrapped CBDC to purchase an NFT on a marketplace. The buyer and seller wallets, as well as the NFT marketplace smart contract, incorporated an 'allow list', which demonstrated the ability to implement controls on who can access tokens on public blockchains. This worked similarly to the KYC attestation on the pilot CBDC platform, flagging KYC'ed users on the public blockchain via the use case platform.

Privacy

During the project, a platform design variant supporting privacy controls at the level of individual transactions and balances was developed. However, in tests this proved to be incompatible with most available wallet software and did not meet industry expectations of transparency in ERC-20 tokens and in the Ethereum ecosystem. So, while a fully private CBDC platform was technically feasible, it would have undermined interoperability of the platform and added significant cost, effort, and complexity for industry participants to integrate with.

Considerations around privacy were relevant not only for the end users of the platform, but also for the organisations operating the platform. In this project, all DLT nodes within the pilot CBDC platform were governed by one party, the RBA. So, although an implementation of the Quorum blockchain network was used, its features to provide privacy between node operators were not relevant in this project.

Key management

Cryptographic keys were required to perform actions on the pilot CBDC platform, and each key carried different levels of authority or power to call functions on the platform. So, key management was important for security. The pilot CBDC platform used a variety of key management and transaction integration components and services, including Metamask, Fireblocks, web3.js, and ethers.js. Industry participants were free to use any client technology compatible with Ethereum.

A finding of the project was that key management is still a challenge in practice for end users of tokenised assets, including stablecoins and the pilot CBDC. Some industry participants were able to quickly integrate with the pilot CBDC platform, but for companies that did not have capability operating on other DLT networks, finding affordable and adequately secure solutions for key management was a challenge. Most blockchain 'wallets' provide key management capability for individuals' use of cryptographic keys for blockchains, but enterprise or institutional use of cryptographic keys typically has additional requirements for revocable access to keys and for multiple levels of approval for critical transactions.

Conclusion

This project, which involved collaboration between the RBA and DFCRC and deep industry engagement, sought to explore potential use cases for a CBDC in Australia. Overall, our assessment is that the project has helped to advance understanding of a range of issues associated with CBDC and the future of money in Australia. At the same time, it identified a number of avenues for future research.

In particular, the project yielded valuable insights into how a CBDC in Australia, possibly alongside other innovations in digital money, could be used by industry to improve the capabilities of the payments system. The various use cases explored in the project highlighted a range of areas where tokenised money could add value, including by facilitating programmable payments, atomic settlement in tokenised asset markets and offline payments. The project also highlighted opportunities for CBDC to support the development of new forms of privately-issued digital money (including tokenised bank deposits or CBDC-backed stablecoins) which could address some of the business needs identified in the use case submissions. In this sense, a CBDC could be viewed as an enabling complement to, rather than substitute for, private sector innovation.

Exploring use cases with a pilot CBDC that was a real claim on the RBA raised a number of legal, regulatory, technical, and operational issues associated with CBDC that warrant further analysis. For example, the project highlighted the need for further analysis of the legal underpinnings for a CBDC, as well as consideration of the regulatory frameworks that could apply to any new business models that may arise.

While the project did not set out to determine the most appropriate technology and design for a CBDC, it identified some issues for further research. For example, the project highlighted challenges in integrating a CBDC platform with industry use case applications, which has implications for potential deployment models. Key non-functional requirements for a CBDC that were not a focus of the project – such as performance, scalability, and security – could also be considered in future research.

More broadly, this project has demonstrated the value in close engagement between industry and policymakers to better understand the opportunities and challenges associated with innovations in digital money. From the outset, the project generated significant industry engagement and the lessons distilled from the exercise were enriched by the active involvement of industry. The project sponsors would like to extend their strong appreciation to the many industry participants who were involved in this project. We would also like to acknowledge the involvement of the staff from ASIC, AUSTRAC and the Treasury who were involved in and supported this project in various ways.

Finally, it is important to recognise the limits in the scope of this project and its place in the broader sweep of CBDC-related research that has been underway for a number of years at the RBA and elsewhere. The project did not set out to provide a complete assessment of the costs, benefits, risks and other implications of introducing a CBDC. Instead, it was more narrowly focused on exploring how a CBDC could be used by industry to enhance the functioning of the payments system. It is our hope and expectation that the findings from this project will help to inform a future research agenda, including further work the project sponsors intend to undertake over the coming years as they explore the policy case for a CBDC. Given the many issues that are yet to be resolved, any decision on a CBDC in Australia is likely to be some years away.



Glossary

Glossary

Address

A unique identifier on a DLT platform. Similar to an account number for a bank account.

Allowance

Authorisation in the ERC-20 token standard that allows an address to transfer tokens controlled by one address to another address. Similar to a direct debit authorisation for a bank account.

AML/CTF (Anti-Money Laundering and Counter Terrorism Financing)

Processes to identify, mitigate and manage the risk of products or services being used for money laundering or terrorism financing.

API (Application Programming Interface)

Set of defined rules and protocols that are used to allow applications and systems to communicate with each other.

Atomic settlement

Process where settlement occurs in an integrated fashion, such that it is technologically infeasible for one leg of a transaction to occur without the other.

ASIC (Australian Securities and Investments Commission)

Australia's integrated corporate, markets, financial services and consumer credit regulator.

Blockchain

A form of distributed ledger technology where transactions are stored in a growing list of blocks that are securely linked together via cryptographic hashes.

AUSTRAC (Australian Transaction Reports and Analysis Centre)

Australia's financial intelligence unit and anti-money laundering and counter-terrorism financing regulator.

CBDC (Central Bank Digital Currency)

Currency issued in digital form by a central bank.

CDD (Customer Due Diligence)

Processes to collect and evaluate information about a customer's risk of illicit activity.

Clearing

The process of transmitting, reconciling and, in some cases, confirming transactions prior to settlement, potentially including the netting of transactions and the establishment of final positions for settlement.

Crypto-asset

A type of private sector digital asset that depends primarily on cryptography and distributed ledger or similar technology.

Custodian

An entity that safekeeps and administers securities or other assets for its customers and that may provide various other services, including clearing and settlement, cash management, foreign exchange transactions, securities lending and collateral management.

Custody

The safekeeping and administration of securities or other assets on behalf of others.

Digital asset

A digital representation of value that can be digitally traded, transferred or used for payment.

DLT (Distributed Ledger Technology)

Protocols and supporting infrastructure that allow computers in different locations to propose and validate transactions and update records in a synchronised way across a network.

DvP (Delivery versus Payment)

A settlement mechanism that links an asset transfer and a funds transfer in such a way as to ensure that delivery occurs if and only if the corresponding payment occurs.

ERC-20

A technical standard for fungible tokens used in Ethereum and related systems.

ESA (Exchange Settlement Account)

An account held at the Reserve Bank of Australia by financial institutions to settle financial obligations arising from the clearing of payments.

Ethereum

Public blockchain system conceived by Vitalik Buterin; or software that implements that system.

Fungible token

A token that is interchangeable with an identical token and divisible into smaller units.

HTLC (Hash Time Locked Contract)

Smart contract that holds digital assets in escrow for conditional transfer to a recipient when a specific secret is revealed or to the originating party when a specific time period has elapsed.

KYC (Know Your Customer)

Regulatory requirements and processes to identify customers, used to support AML/CTF and CDD.

Liquidity

The capacity to sell an asset quickly without significantly affecting the price of that asset. Liquidity is also sometimes used to refer to assets that are highly liquid.

NFC (Near-Field Communication)

A set of communication protocols that enables communication between two electronic devices (e.g. payment cards, smartphones) over a short distance.

NFT (Non-Fungible Token)

A token that has unique characteristics which make it neither interchangeable nor divisible into smaller units.

Pseudonymous privacy

Privacy supported by the use of identifiers for parties that differ from their names.

PvP (Payment versus Payment)

A settlement mechanism that ensures that the final transfer of a payment in one currency occurs if and only if the final transfer of a payment in another currency or currencies takes place.

RITS (Reserve Bank Information and Transfer System)

Australia's high-value settlement system, which is used by banks and other approved institutions to settle their payment obligations on a real-time gross settlement (RTGS) basis.

RTGS (Real-Time Gross Settlement)

The real-time settlement of payments, transfer instructions or other obligations individually on a transaction-by-transaction basis.

Settlement

The discharge of an obligation in accordance with the terms of the underlying contract (e.g. a trade that involves the transfer of funds in exchange for a transfer of assets).

Smart contract

Computer program stored in a distributed ledger where the outcome of the execution of the program is recorded on the distributed ledger.

Stablecoin

A type of crypto-asset designed to maintain a stable value relative to a specified unit of account or store of value, such as a national currency (often the US dollar) or a commodity (e.g. gold).

Token

A digital representation of an interest, a right to receive a benefit or perform specified functions.

Tokenisation

The process of creating a digital representation (token) of an asset on a distributed ledger.



Appendices

APPENDIX 1: Profiles of Use Case Pilots

APPENDIX 2: Project Contributors

APPENDIX 1: Profiles of Use Case Pilots



Australian Bond Exchange – Corporate Bond Settlement

OPPORTUNITY

Corporate bonds currently settle on a T+2 basis. CBDC as a risk-free settlement asset could improve the efficiency of the corporate bond market by allowing equal access for all, reducing settlement times, counterparty risk and enabling atomic settlement of transactions.

PILOT

Demonstrated the use of pilot CBDC to complete near real-time corporate bond purchase, coupon payment and sale of corporate bonds, removing delays between order and settlement. Australian Bond Exchange acted as principal to sell bonds to a small number of selected participants. Participants benefited from quicker issue of holding statements to assure them of investment. For more information visit the [corporate bond settlement use case page](#).



ANZ Bank – Offline Payments

OPPORTUNITY

CBDC could address situations where online connectivity is absent. This includes major outages, communities that lack the means to connect online or those who are unbanked.

PILOT

Demonstrated customer to merchant transactions in an offline environment using NFC-enabled smart cards and pilot CBDC. Two universities, RMIT University and Southern Cross University, participated with students making purchases at on-campus merchants. Merchants accepted pilot CBDC payments via secure apps installed on NFC-enabled devices, while remaining offline. The pilot CBDC smart card enabled a cash-like transfer of value using a familiar form factor. For more information visit the [offline payments use case page](#).



ANZ Bank – SuperStream Payments

OPPORTUNITY

Superannuation contributions via SuperStream currently take many days to transfer payment and allocate contributions to member accounts. CBDC could enable fast settlement with member allocation data, reducing counterparty risk of money in transit.

PILOT

Demonstrated using pilot CBDC in conjunction with SuperStream to make voluntary superannuation contributions with the fund administrator immediately matching SuperStream information with payment. Use of pilot CBDC increased the speed of contribution payments reaching members funds from multiple days to same day. Workflow reduced counterparty risk for money in transit and enabled wallet validation prior to payment to reduce fraud risk. For more information visit the [SuperStream payments use case page](#).



ANZ Bank – Nature-based Asset Trading

OPPORTUNITY

Transition to net-zero is expected to significantly grow demand for nature-based assets. CBDC as a risk-free settlement asset has potential to improve efficiency and reduce risk via atomic settlement of transactions with tokenised nature-based assets.

PILOT

Demonstrated the tokenisation of existing Australian carbon credit units (ACCUs) and real-time settlement of a transaction with the tokens. The use case demonstrated pilot CBDC's utility as 'proof of reserve' for a stablecoin, to allow for atomic settlement on a public permissionless network. The pilot CBDC facilitated efficient trading with reduced counterparty risk. For more information visit the [nature-based asset trading use case page](#).



ANZ Bank – Pilot CBDC Distribution

OPPORTUNITY

CBDC issuance under the CBDC pilot requires holders to undergo KYC and CDD checks. In the pilot, the RBA issues pilot CBDC to institutions who hold ESAs with the RBA, with distribution to other participants managed by ANZ Bank as the nominated distributor.

PILOT

Demonstrated a two-tier distribution of pilot CBDC to industry participants. ANZ conducted KYC/CDD of industry participants, which then requested pilot CBDC through a web portal, deposited Australian dollars into a nominated bank account and received pilot CBDC into their nominated ledger address. ANZ distributed \$235,000 of pilot CBDC to 8 industry participants. For more information visit the [pilot CBDC distribution use case page](#).



Canvas – Tokenised FX Settlement

OPPORTUNITY

Existing foreign exchange (FX) trading & remittance networks do not operate 24/7/365, restricting capabilities for instant trade and transfers globally. The use of CBDC to settle the AUD leg of the tokenised FX transaction can increase speed, operate 24/7/365 and reduce counterparty risk.

PILOT

Demonstrated atomic settlements of pilot CBDC for foreign currency stablecoin (USDC) improving participant liquidity. A select group of end users traded both pilot CBDC to USDC and USDC to pilot CBDC transactions, enabling instant international remittances and foreign exchange (FX). End users benefited from improved capital efficiency with transactions settled in milliseconds, reduced costs and improved exchange rates due to increased trading ability with no cut off time. For more information visit the [tokenised FX settlement use case page](#).



Commonwealth Bank/Intuit – GST Automation

OPPORTUNITY

Businesses carry the responsibility of collecting GST and claiming credits via quarterly Business Activity Statement (BAS). CBDC has the potential to automate the collection and payment of GST by creating a specific GST wallet or account where all GST amounts payable and receivable is automatically calculated, pooled and periodically settled with the ATO, effectively relieving the burden of tax collection on the businesses.

PILOT

Demonstrated the payment of GST through an atomic split payment to multiple receivers using pilot CBDC. Merchants initiated the process via an in-app invoice payment. The proportion of GST for each payment was automatically calculated with GST sent to a holding account to be paid to ATO. For more information visit the [GST automation use case page](#).



Commonwealth Bank – Biodiversity Asset Trading

OPPORTUNITY

Implementation of biodiversity offset schemes face challenges with accessibility, price discovery, transparency and settlement efficiency. Current settlement times can take weeks. CBDC as a risk-free settlement asset could create efficiency in a tokenised biodiversity credit market by providing near-instant settlement with no counterparty risk.

PILOT

Demonstrated an atomic settlement of an existing biodiversity-related credit with wrapped pilot CBDC reducing the settlement time from multiple days to real time. A risk-free and atomic settlement mechanism was seen as valuable to facilitate adoption and scale in an emerging marketplace. For more information visit the [biodiversity asset trading use case page](#).



digi.cash – CBDC Custodial Models

OPPORTUNITY

CBDC has been proposed as complementary to physical cash for retail and business use. Many policy considerations have yet to be explored, and this use case offers the opportunity to trial different custodial models to inform policy choices.

PILOT

Demonstrated three custody models for pilot CBDC: non-custodial holdings, custodial holdings, and custodial holdings with pooled ownership. digi.cash also used pilot CBDC to support the issuance of digital 'banknotes', which were issued in \$5, \$10, \$20, \$50 and \$100 denominations. A small number of individuals trialled each of the custody models conducting a total of 244 transactions. For more information visit the [CBDC custodial models use case page](#).



Fame Capital – Livestock Auction

OPPORTUNITY

Onsite livestock auctions require considerable cost and time investment for both buyer and seller. Financial settlement occurs separately creating risk. CBDC settlement on an online auction platform with multi-party payment could reduce administrative burden and risk.

PILOT

Demonstrated settlement of livestock auctions using an online auction platform. Selected wholesale clients pre-fund wallets with pilot CBDC. Completed auction triggered auction operator to conduct peer-peer settlement with automatic payment of fees and levies. For more information visit the [livestock auction use case page](#).



Imperium Markets – Tokenised HQLA Securities Trading

OPPORTUNITY

Wholesale debt capital markets and money markets have the potential to be more efficient, transparent and accessible to all participants (both issuers and investors) by implementation of atomic settlement using CBDC. The pilot enables an existing market operator to achieve 'delivery versus payment' on securities that fund the banking system. Market participants control the ownership and movement of funds to enable financial clearing and settlement at reduced costs, without any financial risks from a intermediary.

PILOT

Demonstrated atomic settlement of major bank certificates of deposit issued by and traded between two authorised deposit-taking institutions (ADIs), Westpac and Commonwealth Bank. Participants controlled the ownership and movement of pilot CBDC. Each trade was individually settled with pilot CBDC enabling financial clearing and settlement at reduced costs, and no counterparty risk. For more information visit the [tokenised HQLA securities trading use case page](#).



Mastercard – Interoperable CBDC for Web3 Commerce

OPPORTUNITY

Consumers participating in Web3 commerce do so across multiple blockchains, including public blockchains. Today, their only option of payment is private forms of cryptocurrency that pose varying degrees of risk. CBDC could provide a safe settlement asset that can be leveraged across a range of blockchain ecosystems.

PILOT

Demonstrated a purchase of an NFT listed on the Ethereum public blockchain using wrapped pilot CBDC. The buyer and seller wallets, as well as the NFT marketplace smart contract were allowed-listed demonstrating the ability to implement controls on public blockchains. A risk-free backing asset and ability to transact only with appropriately registered users provided security and assurance to participants. For more information visit the [interoperable CBDC for Web3 commerce use case page](#).



Monoova – Cross-border Settlement & Custody

OPPORTUNITY

Certain non-bank financial institutions (NBFIs) do not have access to an ESA at the RBA. Custody or intermediary roles introduce financial risk and additional regulatory burdens for the NBFIs and their clients. CBDC as a settlement token with no counter-party risk offers clear, high trust reporting and faster on-off ramps into national currencies or other value tokens.

PILOT

Demonstrated improved efficiency and risk mitigation of the AUD component of FX transactions using pilot CBDC held in custodial accounts for settlement. End users held pilot CBDC in individual custodial accounts directly with the RBA which eliminated counterparty risk and improved traceability and transparency. For more information visit the [cross-border settlement and custody use case page](#).



NotCentralised – Construction Payments

OPPORTUNITY

Construction company failures happen frequently due to disputes over scope of work, lack of payment visibility, delayed or missed payments and uncertainty over available liquidity. Programmable payments using CBDC could remove counterparty risk, allow contractors to verify available funds, and the conditions for payment, before commencing work.

PILOT

Demonstrated milestone-based, oracle-driven payments for a commercial renovation project. Pilot CBDC provided counterparty risk mitigation through a risk-free backing asset to a private stablecoin. End users agreed to contract terms and payment schedules on-chain with fund verification through zero knowledge proofs providing commercial confidentiality. An oracle feed confirmation triggered payment of agreed value to the payee. For more information visit the [construction payments use case page](#).



Novatti – Stablecoin Proof of Reserve

OPPORTUNITY

For universal adoption and acceptance, increased confidence in stablecoins is needed. Current methods rely on third party accreditation that is not verifiable at the token level. CBDC could provide a credible, risk-free backing in central bank money of private stablecoins that allows users to independently verify the token reserves.

PILOT

Demonstrated the use of a HTLC to guarantee a stablecoin (eAUDD) backed by pilot CBDC, minted on the Stellar blockchain. Participants could independently verify the HTLC to ensure this privately issued stablecoin had sufficient pilot CBDC backing the stablecoin. eAUDD was used to purchase an NFT for charitable donation. For more information visit the [stablecoin proof of reserve use case page](#).



Unizon – Tokenised Bills

OPPORTUNITY

Supply chain finance has traditionally been burdened with human-error, delays in payment and liquidity issues for businesses. Tokenised on-chain invoices could improve transparency and efficiency, becoming authenticated tradable assets that can be paid immediately, resold, split or merged. Payment using CBDC removes counterparty risk between multiparty settlements.

PILOT

Demonstrated the issuance, third party sale and payment of a tokenised invoice. Pilot CBDC facilitated programmable payments that automatically split and forwarded the corresponding value to multiple receivers on invoice payment, eliminating counterparty risk. For more information visit the [tokenised bills use case page](#).

APPENDIX 2: Project Contributors

We would like to extend our appreciation to everyone who submitted use cases, as well as the following individuals and organisations who contributed time and effort to the project.

Steering Committee

- Dr Tony Richards,
Independent Chair
- Dr Brad Jones,
Reserve Bank of Australia
- Dr Andreas Furche,
Digital Finance CRC
- Nghi Luu,
Australian Treasury

Project Director

- Dilip Rao,
Digital Finance CRC

Project Team

Reserve Bank of Australia

- Chris Thompson
- Cameron Dark
- Richard Davis
- Anna Douderina
- Dr Adam Gorajek
- John Kenyon
- James MacNaughton

Digital Finance CRC

- Dr Mark Staples
- Regnier Avice
- Paul Brun
- Vincent Jadraque
- Hung Nguyen
- Yilin Sai
- Raveen Senanayake

Supporting Organisations

Australian Treasury

Australian Securities and Investments Commission

Australian Transaction Reports and Analysis Centre

Support Partners

- Allens
- EY
- Fireblocks
- Kaleido

Industry Participants

- ANZ Bank
- ANZ Worldline Payment Solutions
- Australian Administration Services (Link Group)
- Australian Bond Exchange
- Canvas Digital
- Capgemini Australia
- CBUS
- Commonwealth Bank
- Cuscal Limited
- digi.cash
- Digital Mutual
- Fame Capital
- Grow Inc
- H.E.S.T Australia
- Hedera
- Imperium Markets
- Intuit Australia
- Mastercard Asia Pacific Pte Ltd
- Monoova
- NotCentralised
- Novatti Group
- Oban
- RMIT University
- Secretarium
- Southern Cross University
- Thales DIS France SAS
- Unizon
- Zerocap

Other Contributors

- Australian Securities Exchange
- Battlerz Fintech
- Binance
- Blockstars Technology
- Blue Biometrics Pty Ltd
- Civic Ledger Pty Ltd
- Client Fabric Tech
- CSIRO
- Deloitte
- DigitalX Limited
- Geora Pty Ltd
- Get Paid in Bitcoin
- Giesecke + Devrient
- Google Australia Pty Ltd
- Kobl Pty Ltd
- Launtel
- Lowry Consulting Pty Ltd
- LUCA Plus Pty Ltd
- MainClear Pty Ltd
- Metaco SA
- Microsoft Pty Ltd
- National Australia Bank
- NCR
- ODMOB Lawyers
- Oracle
- Partior
- Ripple Labs Inc.
- Dr Peter Robinson
- Syrax
- Trovio
- Westpac Banking Corporation
- Yarta Pty Ltd
- Zepto

© Reserve Bank of Australia 2023. All rights reserved.
The contents of this publication shall not be reproduced, sold or distributed without the prior consent of the Reserve Bank of Australia.

ISBN 978-0-6456221-2-6 (Online)

This project received grant funding from the Australian Government through the CRC Program.



Australian Government
Department of Industry,
Science and Resources

AusIndustry
Cooperative Research
Centres Program



RESERVE BANK
OF AUSTRALIA

DFCRC DIGITAL
THE FUTURE OF FINANCE FINANCE
CRC