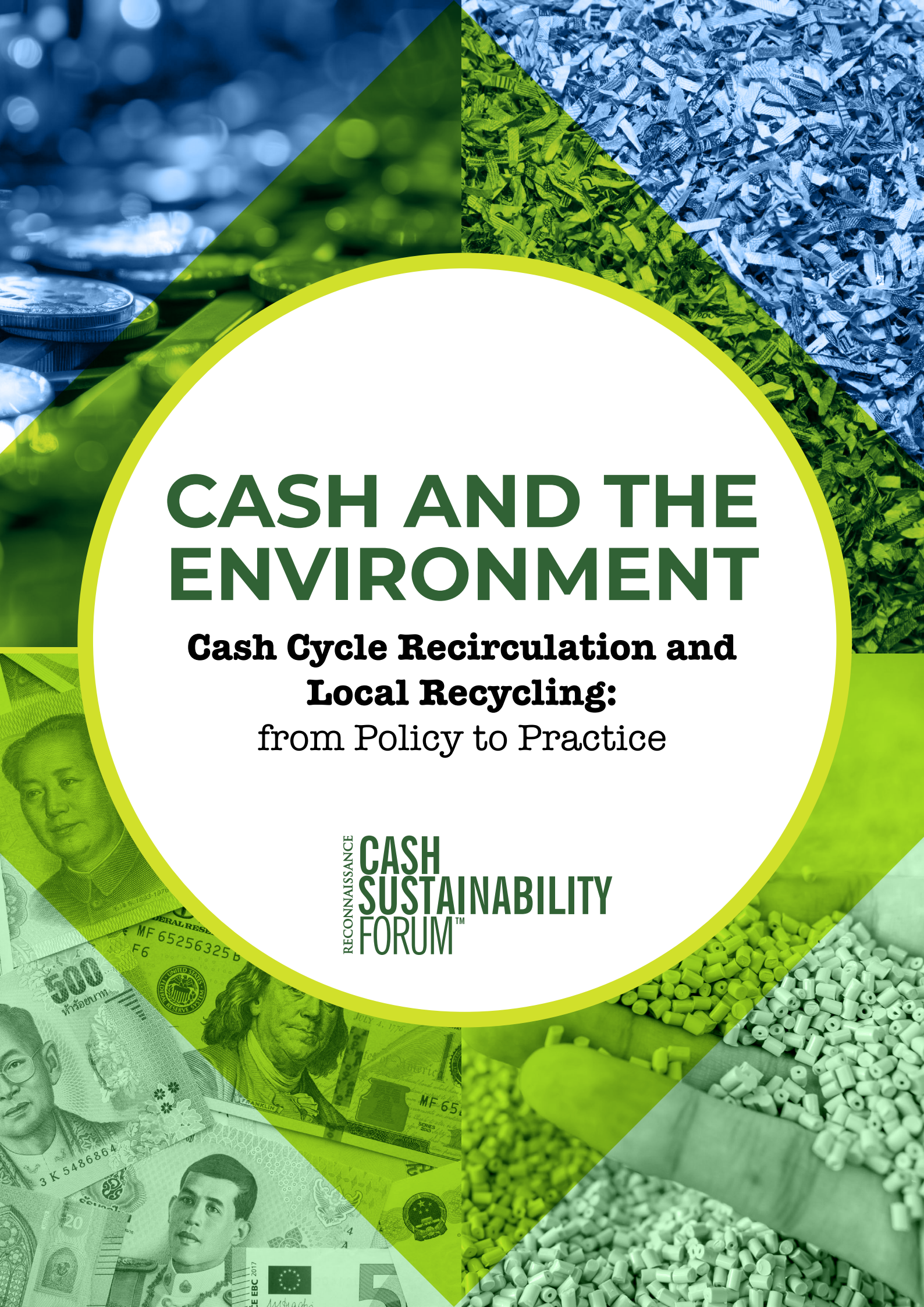


CASH AND THE ENVIRONMENT

Cash Cycle Recirculation and Local Recycling:

from Policy to Practice

RECONNAISSANCE CASH SUSTAINABILITY FORUM™

ACKNOWLEDGEMENTS

This paper has been produced based on extensive interviews, surveys and conversations, formal and informal, across central banks, mints and a wide range of cash cycle stakeholders, among them:

Asian Cash Management Association

ATM Industry Association

Auriga

Bango Sentral ng Pilipinas

Bank of Canada

Bank of England

Bank of Mexico

Bantas

Brinks Global Services

Cash Infra Pro

Diebold Nixdorf

Dutch National Bank

Geldmaat

NatWest Bank

NCR Atleos

Nedbank

Npower

Oberthur Cash Protection

Piraeus Bank

Royal Canadian Mint

South African Reserve Bank

THG Eco

Virgin Money (now part of Nationwide)

In addition, this paper was written with the support of the ATM Industry Association (ATMIA) who introduced us to a number of contributing organisations. We are grateful for their support and active interest in this project.

We would like to thank all those with whom we have spoken, or who have provided us with information and support.

AUTHORS

John Winchcombe

John Winchcombe has worked with central banks on the design, issue and circulation of banknotes from joining De La Rue in 1988 to today. His De La Rue career included working in banknote paper mill and print works, responsibility for new product development of paper, polymer, print, machine readable and optical features for banknotes and marketing strategy. John's last job at De La Rue involved four years as Product Development and Marketing Director for the Currency business.

In 2016, after leaving De La Rue, John worked for CCL Secure and in 2018 he started work as a consultant, firstly for 7 Layer Solutions and then also with Reconnaissance International.

John's work for Reconnaissance is to bring his knowledge of central banks, banknote manufacture, banknotes and the entire cash cycle into the business, including putting this into the wider payment context as alternative and digital payment methods develop and grow in popularity.

Paul Blond, Managing Partner, The Blond Group LLP

Paul is Managing Partner of specialist currency and payments advisory firm The Blond Group LLP.

With a background in retail and private banking, Paul has worked across the currency and payments industry around the world for more than 30 years.

Working closely with many central banks, banking associations, commercial banks, cash logistics companies and other cash and payment stakeholders, Paul has an in-depth understanding of global cash and payments issues past, present, and emerging.

Paul has successfully completed a wide range of strategic and operational assignments that have ranged from advising central banks on currency recirculation policies and national cash and payments strategies, through to the end-to-end multi-year delivery of a new currency series rollout for Australia's largest commercial banking group.

Paul frequently contributes to industry thought leadership work and is a regular presenter at industry conferences.

CONTENTS

ABBREVIATIONS

ATM	Automated Teller Machine
BEM	Banknote Equipment Manufacturer
BOE	Bank of England
CBRT	Central Bank of the Republic of Türkiye
CDP	Carbon Disclosure Project
CI	Custodial Inventory
CIEC	Cash Industry Environment Charter
CIT	Cash in Transit
CO2e	Carbon Dioxide Equivalent
DNB	Dutch National Bank
ECB	European Central Bank
ECI	Extended Custodial Inventory
GHG	Green House Gas
IBNS	Intelligent Banknote Neutralisation System
ICMS	Integrated Cash Management System
LCA	Life Cycle Analysis
LED	Light Emitting Diode
NCC	National Coin Committee
NCB	National Central Bank
NCS	Note Circulation Scheme
NHTO	Note-Held-to-Order
NQRS	Note Quality Reward Scheme
OTC	Over the Counter
PEF	Product Environmental Footprint
POS	Point-of-Sale
SARB	South African Reserve Bank
UNSDG	United Nations Sustainable Development Goals

EXECUTIVE SUMMARY

The backdrop to this paper is the European Central Bank's Product Environmental Footprint study, which found that 82% of the environmental impact of banknotes happened post-issue; hence a paper dedicated to exploring cash recirculation and local recycling from every angle.

While the starting assumption of the paper is that it is the job of central banks to reduce this environmental impact, the conclusion is more nuanced than that.

We describe a broad range of opportunities for central banks, directly or indirectly, to mandate, incentivise or guide behaviour, albeit some of the levers can lie with other government agencies (eg. licensing cash-in-transit (CIT) companies by the police). As the handling of cash moves away from commercial banks and cash centres, there is a sense that the reach of central banks is weaker. To what extent is that true?

Every cash cycle is unique because the business cases are different due to how stakeholders interact. Understand the culture of the central bank, the strength of the regulatory regime and what is required, alongside how each stakeholder makes money, and that determines who is doing what and how willingly. If change is needed, understanding these dynamics is needed. We provide an overview of four types of cash cycle and their characteristics, and it will be interesting to see how these evolve over time.

Today payments are changing, and, with that, long stable cash cycles are also on the move. In addition to changing cash transaction volumes, in many countries higher interest rates have both altered cash demand and the cost of owning/ providing cash. Off-balance sheet relief schemes are now more valuable and, with the advent of Smartsafes, could be extended even into the retail sector, particularly if CITs are unable to pass on their cash ownership costs to retailers.

While the central bank case studies in this paper provide detail about how they are addressing problems to make the cash cycle efficient and to reduce its environmental impact, the industry case studies may point more to the future and how cash is evolving.

Evidence from Auriga, Bantas, Brinks, Diebold Nixdorf, NCR Atleos, and a high-level look at what is changing in Asia, point towards:

- New business models built on more capable cash handling machines designed for low lifetime environmental impacts
- New relationships with retailers and cash management companies
- Massive exploitation of data to use less cash and to move it less
- Collaboration across organisations to have the right infrastructure etc.

This is a long paper replete with detail right through to the last Annex. Pick and choose what to read but, whatever your challenge, you are likely to find either others have gone before you or new thinking.

We look forward to your feedback.

ACTION REQUIRED

We already understand much of what we need to do to get to net zero in the post-issue cash cycle:

- Buy and use renewable energy (responsibly) to power ATMs, point-of-sale (POS), and cash handling devices
- Move to electric CIT vehicles for all but the longest routes – IBNS (Intelligent Banknote Neutralisation) systems may be needed to make this possible
- Reduce cash miles travelled by mastering the art of managing local recycling. This will include capable machines, great data collection, and collaboration across all parties.
- Consider 'utility' infrastructure across ATMs and cash centres.

Alongside this we need to do the 'day job' well – have the right denominational structures, use the most sustainable and durable materials, develop regulatory regimes that support cash cycles, and dispose of waste as well as we can.

The benefits of a sustainable cash cycle walk hand in hand with the efficiency needed to address the challenge of when the cash infrastructure shrinks to a point where it accelerates the move away from cash and the business model for cash cycle stakeholders no longer works.

The cash management organisations who have contributed to this paper have shown how more capable devices and different ATM, retail and cash centre business models make cash more convenient, lower cost, and greener. While the cash industry can walk much of this path alone, history shows central banks can remove barriers, and both enable and push change.

There is an opportunity, and a need, to think deeply about organising a modern cash cycle that is efficient, resilient and sustainable. Collaboration, co-operation, and clear thinking will be needed.

1. WHY READ THIS PAPER?

A cash cycle that works today may not be the optimum system tomorrow. There is the need, therefore, to optimise the cash cycle both to reduce its environmental impact and to respond to changing payment habits.

1.1 WHAT IS CHANGING?

The growth of digital payments is starting to change cash usage. Business models that have underpinned cash cycles are changing, causing commercial banks and cash management companies to change as well. Technology is also providing new methods for handling and managing cash.

1.2 WHY IS THIS PAPER NEEDED?

Cash circulation is becoming an area of focus for central banks, and others, to make changes to reduce the environmental impact of cash. Recirculation and local recycling are shaped by central bank policies alongside the commercial and operational realities of cash cycle stakeholders, which gives the context for how they do their business. If central bank policy changes increase costs for stakeholders, ultimately these are paid for by society, either as a financial cost or in the service level delivered.

In that context, there is a need to understand the cash cycle better and the implications of making changes to it.

1.3 WHO IS THIS PAPER FOR?

This paper is for all stakeholders in the cash cycle because recirculation and local recycling affects almost all of them – central and commercial banks, cash centre operators, banknote equipment manufacturers (BEM), cash management software suppliers, ATM management companies, and CIT companies. This paper takes a global perspective.

HOW THIS PAPER IS ORGANISED

This paper starts by providing data from the latest Life Cycle Analysis (LCA) of a cash cycle and some thoughts on getting to net zero carbon emissions and who should lead change. It looks at decisions central banks make prior to the issue of currency that have an impact on the environmental impact of banknotes during their lives, from the substrate and design choices through to the denominational structure.

The paper then focuses on the cash cycle itself, starting with how it can be organised and the challenges it currently faces. This gives the context for change.

Staying with a central bank focus, the paper lays out in detail a wide range of levers that a central bank can use to manage the cash cycle, some direct and some indirect. Some of these cross over to agenda items such as resilience and cash access.

Off-balance sheet relief schemes are well established and there are a range of ways to implement them. As the profit earned by the private sector falls and as interest rates add to the cost of holding cash for all stakeholders, understanding off-balance sheet relief schemes is important and the paper provides rich detail about them.

Local recycling can significantly reduce cash movements, and the private sector has a range of equipment and business solutions to meet these needs. There is scope to make major positive changes if this can be encouraged and managed well.

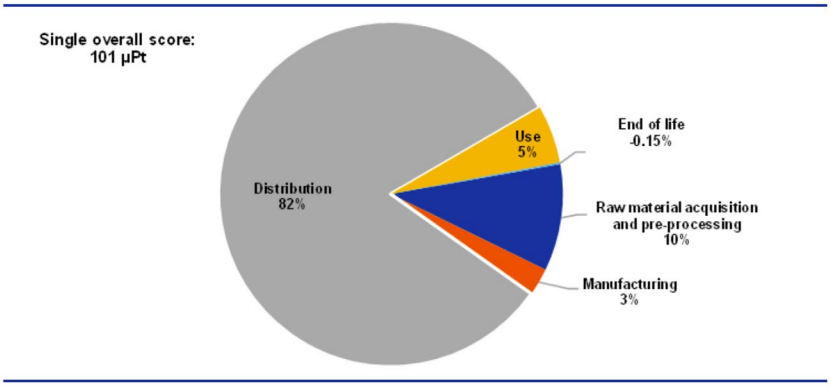
Several case studies have been written following conversations with central banks, mints, and cash cycle stakeholders. They have been included to offer real-life evidence and examples of what is being discussed in this paper, moving from theory to practice.

2. IMPACT OF CASH ON THE ENVIRONMENT

2.1 LIFE CYCLE ANALYSIS (LCA)

LCA of the cash cycle by numerous banks all conclude that the circulation of cash is where the biggest environmental impact takes place, followed by the production of cash. The end of life of cash has a small impact but is a highly visible statement of a central bank's regard for the environment.

Percentage contribution of each life cycle stage to the single overall environmental score



© ECB. Source: Environmental Footprint Study on Payments with Euro Banknotes: Chart 1.[1]

2.2 AREAS UNDER THE DIRECT CONTROL OF A CENTRAL BANK

In this context central bank issue departments have direct control over the production of cash and what happens to it at its end of life.

If fewer banknotes and coins are needed and if they are moved around less, then the environmental impact will be reduced. Reducing the velocity of circulation of banknotes, ie. how hard they work, allows them to last longer. An efficient denominational structure for coins and banknotes, an optimum number of coins and banknotes per head of population, and an effective mechanism for withdrawing distressed cash makes a significant difference (See **"Annex A: Banknote design optimisation"** on page 43 for detailed information).

As does the specification of the banknote – from using a durable substrate to selecting appropriate security features and designs.

1 Product Environmental Footprint study of euro banknotes as a payment instrument (europa.eu).

ECB PEF

The European Central Bank (ECB) carried out a Product Environment Footprint (PEF) study in December 2023 focusing on the creation and life cycle of banknotes through to their disposal when they become unfit to circulate. The PEF allows the ECB to understand the potential end-to-end environmental impact of banknotes as a payment instrument and identify aspects of the lifecycle that can reduce that impact.

The output of the PEF was a single overall score for the average annual value of cash payments for a Euro Area Citizen (EAC) in 2019, 101 micro points. This is the equivalent of driving a standard car 8km. The ECB put that in context by comparing it with buying a cotton T shirt and then washing it once a week for a year, which has an EAC equivalent of 55km, or the manufacture of 71 one and a half litre bottles of water, the average consumption of a European Union (EU) citizen in a year, which is 272km.

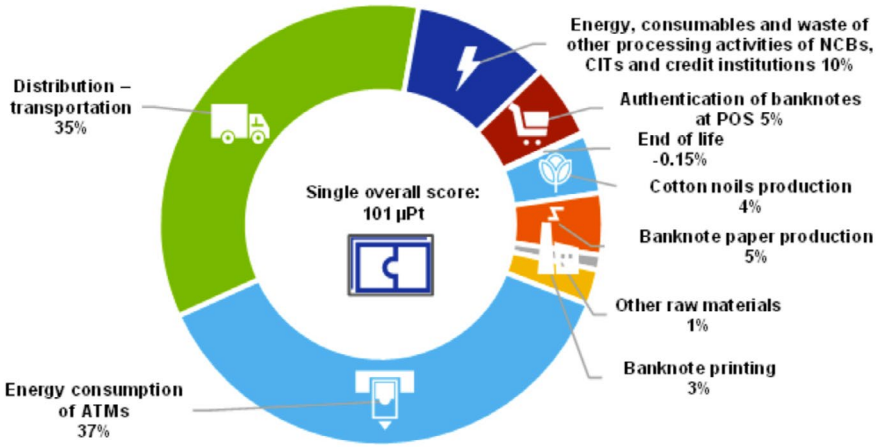
As with other LCAs, this PEF also found that the energy consumption of ATMs and transportation had the biggest impact, followed by the processing of banknotes by National Central Banks (NCBs), paper manufacturing and the authentication of banknotes in shops. This last finding is different from other LCAs.

While ATMs were responsible for 37% of the total impact, ATM manufacturers, working with credit institutions, have reduced the contribution of ATMs to the PEF score by 35% between 2004 and 2019. The transportation of banknotes accounts for 35% of the total, and considerable work has been done on transport optimisation. Further work continues, including looking at the use of sustainable fuels. Authentication at the point-of-sale (POS) accounts for 5% of the total impact.

Continued on page 10

ECB PEF: ENVIRONMENTAL IMPACT BY ACTIVITY

Single overall score subdivided by activities and their percentage contributions



© ECB. Source: Environmental Footprint Study on Payments with Euro Banknotes: Chart 2 (Product Environmental Footprint study of euro banknotes as a payment instrument (europa.eu).

The ECB used version 2.0 of the European Commission's PEF methodology. This is an LCA-based methodology that covers 16 environmental impact categories, including climate change owing to greenhouse gas emissions, ozone depletion, land and water use, and resource depletion. It is a more detailed approach than other LCA methodologies, which only consider one or few impact categories (eg. climate change owing to greenhouse gas emissions).

2.3 AREAS UNDER THE INDIRECT CONTROL OF CENTRAL BANKS

Central bank control over the cash cycle varies depending on its direct role in cash management, its regulatory authority, and the policies it pursues. The ability of a central bank indirectly to influence, 'nudge', and guide can often be significant.

Within the cash cycle the two biggest areas of impact are the electricity used to power ATMs and other cash handling devices, and the fossil fuels used to move cash. Clearly other factors also impact the environment – plastic waste, infrastructure costs etc. – but they are relatively small compared with the other two.

Reducing movement of cash

The closer to the point-of-use that cash can be fitness checked and authenticated, the shorter the distances it must be moved. The trend is to allow the commercial sector to do this without returning cash to the central bank. Balance sheet relief schemes, such as Note-Held-to-Order (NHTO) schemes, reporting regulations, device certification and inspection programmes, CIT regulations etc. can make up a part of a recirculation policy.

A 2022 Reconnaissance survey of central banks confirmed that almost all have recirculation policies, although with significant variation in what is allowed and how it is managed.

Getting ATMs to Net Zero

Given the target of getting to net zero carbon emissions by 2050– with most organisations aiming to achieve this much earlier – and that the ECB's PEF found that energy consumption by ATMs had the biggest single impact on the environment in the cash cycle, what are the options to:

- Reduce ATM power usage?
- Buy renewable energy well?
- Offset the carbon emissions while transitioning to 100% renewable energy?

The ability of a central bank to intervene to achieve net zero for ATMs will vary by country. It is likely that for most countries the responsibility for making this happens lies outside of the central bank.

Best practice recommends that organisations measure, reduce and, only then, offset (See **"Annex B: ATMs and Net Zero"** on page 44 for details).

3. WHO SHOULD LEAD IN INCREASING SUSTAINABILITY?

Who is responsible for promoting change around environmental sustainability? Many assume it is central banks. Stakeholders are used to central banks having and exercising levers of direct control over the cash cycle through their licensing of CIT companies, regulatory authority over commercial banks, legal responsibility handed down by parliaments etc. Data reporting requirements, security guidance, control over note issuance and receipt, rules and regulations etc. all give opportunities for direct or indirect control, for example through influencing insurance limits on cash held.

But sustainability is, perhaps, different because it is not to do with risk or operational performance. Although central banks can use some of their traditional 'levers', do these work as well around sustainability? We would argue that suggesting that the 'government' should lead can be a recipe for inaction. Cash cycle stakeholders should strive to reduce the environmental impact of cash without waiting for others to act.

Central banks and 'soft' power

Central banks also offer a 'moral' power to influence behaviour, although the bottom line often holds sway. Providing 'guidance' and bringing together stakeholders who don't normally meet allows central banks to set the agenda and point towards a future path.

The cash cycle has numerous associations and industry bodies, both regional and international, that allow stakeholders to work together and interact with other cash cycle groups – bankers associations, the ATM Industry Association, the European Security Transport Association, Security Ligue, the Asian Cash Management Association, the International Currency Association etc. – and many of these have sustainability charters and working groups. This offers a route to change.

The UK has what appears to be a unique approach – unique because a commercial bank has led the formation of an industry wide sustainability group.

NatWest Group is one of the UK's four largest commercial banks and is made up of NatWest Bank, the Royal Bank of Scotland and Ulster Bank. It is a member of the Bank of England's Note Circulation Scheme and, through the Royal Bank of Scotland, designs, issues and circulates banknotes in Scotland, while its subsidiary Ulster Bank issues notes in Northern Ireland. NatWest is active on a wide range of sustainability activities and in September 2020 it invited 34 organisations[2] to join an online call to discuss the UK's cash cycle and collaborate to reduce its environmental impact.

The Cash Industry Environmental Charter (CIEC) Group, as it became known, became a formal grouping in January 2021 when eight organisations signed the charter committing them to achieving four targets. 26 organisations continue to meet regularly and to work together (See **'"Annex C: UK's Cash Industry Environmental Charter (CIEC) Group: Collective Change"** on page 45 for more information).

Each country is different. So, who leads and how it is achieved will vary accordingly.

2 The 'owners' of the UK's cash (the Bank of England and the Treasury), banknote and coin production (De La Rue and The Royal Mint), commercial banks (13 organisations), retailers (two organisations), machine suppliers (five organisations), ATMs (Link and CMS Analytics), CIT (two organisations), other suppliers (four organisations), associations (UK Finance and British Retail Consortium (BRC), and press organisations (Reconnaissance and Chartered Banker).

4. THE CASH CYCLE

4.1 THE ROLE OF THE CENTRAL BANK

The role of a central bank may vary from country to country, but invariably the organisation will hold the exclusive right to issue banknotes (and coin also, in most, but not all, countries) and will most likely be charged with ensuring the efficiency and stability of the payments system. As cash is an integral part of most payment systems, both for day-to-day and backup transaction purposes, then the central banks' role cannot be limited to simply the issue of currency, but at least to some degree, must include safeguarding the efficiency and resilience of the cash cycle.

To an extent, all central banks and monetary authorities actively operate in and manage the cash cycle and recirculation of cash. Issue, distribution and destruction are discussed in **"Annex D: How central banks decentralise cash management to the private sector"** on page 46.

4.2 BUSINESS MODEL FOR DECENTRALISED CASH

At the start of this century, when cash was booming, many central banks started moving cash management activities to the private sector. At **"Annex D: How central banks decentralise cash management to the private sector"** on page 46 are the tools used by central banks to make this change, although coercion of the private sector to get involved was not really needed at that time. Commercial banks made money from issuing and receiving cash, CITs made money from cash delivery, and ATM and cash management companies made money from fees. It made sense for all to invest in infrastructure, processes, and service. The volumes involved were significant and more than paid for their investment and operational costs.

4.3 THE VOLUME INFRASTRUCTURE CHALLENGE

If cash volumes fall below a certain point, then the scale of infrastructure needed to maintain robust cash access to society becomes uneconomic. At this point the profit motive, which is what drives businesses, means that the business model for cash cycles no long works. If central banks have maintained a centralised system with their own branches and cash centres, a cash crisis can be mitigated at least for a while.

The seriousness of this challenge is reflected in the Swedish Riksbank building two new cash centres, with a further two opening by 1 January 2026, and the current turmoil in Australia where banks don't want to handle cash. There is only one CIT company in Australia and it has the upper hand in negotiations across the supply chain (see page 17).

Central banks need to understand the business case of stakeholders across the entire cash cycle and be clear on how they will maintain cash in both a less cash world and a world where the banks withdraw from cash services. Depending on where an economy is on its less cash journey, central banks can then decide whether to provide cash cycle services themselves or how to incentivise the private sector.

4.4 HOW THE CASH CYCLE IS CHANGING

A simple model of cash was that it was issued by a central bank and then it circulated. Banknotes were 'recycled' by people deciding to trust the banknote they'd received and to spend it themselves in due course. The central bank had, and has, no control over this. At some point a commercial bank, business, or individual would visit a central bank branch and hand in a tired old banknote for a new one.

Growing wealth on the back of industrialisation saw an increase in banking and a sharp increase in the circulation of banknotes. While there were counting machines, machine authentication is only decades old. The central bank issued and took back notes and sorted and reissued notes it deemed fit.

The real 'revolution' was the advent of the ATM since it gave people access to cash day or night. The machines needed to be kept stocked and banks needed to be confident that the notes put in were genuine. Now fitness checking and authentication needed to happen at scale and the role of the central bank has been increasingly indirect (See **"Annex E: Overview and comparison of central bank cash handling models"** on page 48) for a full description of the characteristics of each model by:

- Currency design and manufacture
- Issue and distribution
- Recirculation of fit currency
- Return of seasonal surplus currency
- Return of unfit currency
- Interbank trading to meet surplus/deficits
- Off-balance sheet relief/incentives
- Penalties
- Currency destruction
- Commercial sector counterparties
- Role of cash logistics/CIT companies
- Industry market oversight and regulation..

4.5 THE COMING REVOLUTION

The revolution is a reaction to the unwillingness of the commercial sector to provide cash services. Highly localised recycling appears to be a growing response. Below is evidence from three organisations of the impact of recycling.

- **Brinks**

  Brinks have shared how in the Netherlands they pick up cash from a large retailer, sort it locally and then restock ATMs in the neighbourhood.

  Further details can be found under **"9.3 Brinks Global ATM Solutions"** on page 38.

- **Reserve Bank of New Zealand**

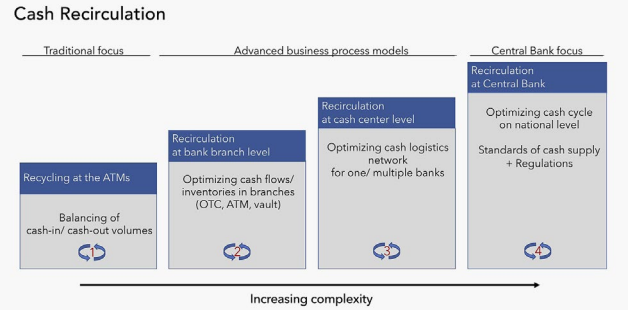
  RBNZ is running a trial during 2025 where retailers are paid to provide cash services in parts of the country where the commercial sector has withdrawn bank branches and ATMs.

- **Piraeus Bank**

  Piraeus has provided evidence that recycling machines work. It has 900 ATMs that accept deposits as well as issue cash, and 1,250 issue-only ATMs. The recycling ATMs had 247,761 cash withdrawals before a replenishment visit to the machine, compared with 94,993 withdrawals for a non-recycling ATM. The annual figures for off-site ATMs between 2019 and 2023 show a 19% reduction in CIT routes, a 14 tonne reduction in diesel used, and a 35% reduction in CO_2 emissions.

  CIT reserves are the balances held at the banks by the CIT company ready for replenishing the ATMs. The daily average ATM cash returns of fit notes was €6.7 million, and notes required to be shipped out for ATM replenishments was €21.8 million. 31% of the daily ATM cash replenishment demand could be met by CIT money returned from ATMs and held in the CIT cash reserves.

  In the cash processing centres, of which Piraeus has five, only €161 million must be sourced from the Bank of Greece with 64% coming from recirculation.



Source: Cash Infra Pro

If cash 'recirculation' happens in cash centres, for the purposes of this paper, 'recycling' is when cash is being reissued outside of cash centres.

4.6 DIFFERENT CENTRAL BANK APPROACHES TO CASH HANDLING

As the sole issuer of currency, central banks have traditionally undertaken a significant and key role in the cash supply chain. As a result, the issue department usually has one of the largest budgets, the biggest workforce, and a directly operational role.

Invariably, central banks retain responsibility for currency design, manufacture and new issue, and for the final authentication and destruction of unfit or old currency. However, the degree to which cash is handled between these first and last activities varies.

Central bank approaches can be categorised in several ways depending on their end-to-end involvement in the cash cycle. In this white paper we have chosen to describe four broad categories:

- **Traditional**

  The central bank has its own cash centre and does all cash processing in the economy.

- **Restricted**

  The central bank allows cash processing in addition to its own, at specified and regulated cash centres. Unfit notes are returned to the central bank.

- **Supported**

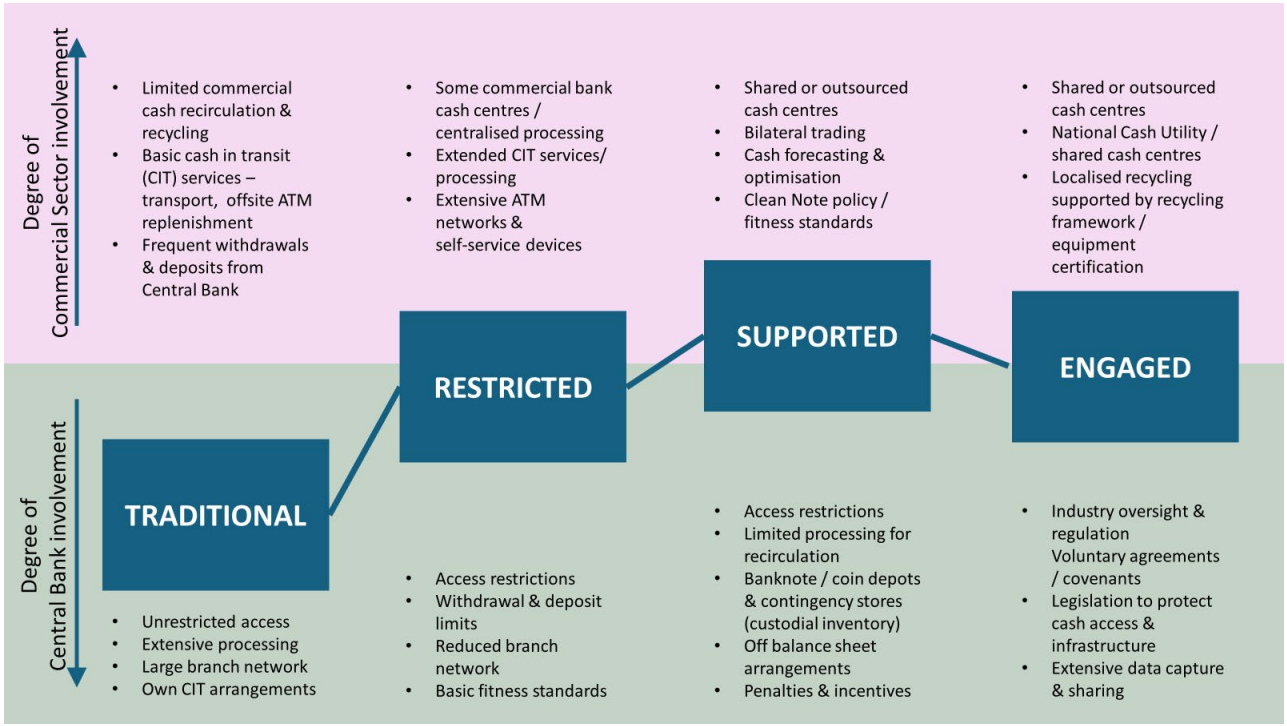
  The central bank has largely outsourced cash processing and unfit notes are returned to the central bank. Balance sheet relief schemes support institutions.

- **Engaged**

  The central bank is actively engaged in ensuring the efficiency of the cash cycle including taking steps to standardise packaging, labelling, data flows, and interbank exchanges etc.

There is no 'natural' or inevitable progression. We have described characteristics of each in the diagram below.

Cash Cycle Models



5. CENTRAL BANK CASH CYCLE MANAGEMENT TOOLS

Central banks can deploy a range of levers to influence cash handling, recirculation and recycling, a mix of incentives and penalties.

5.1 DESTRUCTION

This is first in the list of management tools because the exclusive right of a central bank to authenticate and destroy currency gives it the ability to control note quality. By sampling the note returns from the private sector, the central bank can assess whether the private sector is returning notes that are fit for reissue or notes that are much worse than expected. These private sector organisations face penalties for mismanaging their note quality.

OUTSOURCING BANKNOTE DESTRUCTION

Some central banks may be empowered to delegate destruction, and this was the case with the Norges Bank, Norway's central bank. To date it remains the only central bank that has outsourced banknote destruction to a commercial company. Norsk Kontantservice AS (NOKAS) was established in 2001 and is jointly owned by several Norwegian commercial banks. It was initially 33.5% owned by Norges Bank (which subsequently sold its stake).

Norges Bank established strict guidelines for the outsourced banknote destruction, specifying automated banknote sorting equipment and associated software to ensure that only agreed banknotes (old series and current series notes meeting unfit note criteria) could be destroyed with no manual intervention. Equipment software was upgraded to ensure that the operator could not adjust any of the machine settings. Outsourced operations started in 2002 and continued until 2013 when, prompted by a move in NOKAS's Oslo premises which made destruction no longer possible, Norges Bank took back the destruction of notes.

5.2 MANAGING CURRENCY FITNESS

5.2.1 Clean note standard

Unless running a fully centralised system, a central bank will need to have policies and mechanisms to manage the authentication and fitness standards of notes in circulation.

A clean note policy starts with establishing a standard for unfit banknotes based on visual and machine sorting. Usually test decks are provided by the central bank to allow commercial organisations to calibrate and test their systems to meet the standard.

The clean note policy sets out expectations for currency fitness not only on return to the central bank, but across the supply chain. Again, these policies can be by way of written regulation or through more elaborate policies that evaluate, accredit and approve banknote equipment capable of fitness sorting and authenticating banknotes. Banknote equipment certification and inspection is described below.

As the sophistication and types of banknote sorting equipment vary considerably, careful thought must be given as to how unfit banknote standards are set and policed. For example, in South Africa the Reserve Bank sets a tolerance limit between what is commercially sorted as unfit, and the settings used on its own high-speed sorting and destruction equipment.

5.2.2 Banknote sorting framework

While early fitness standards were largely set out as descriptive documents specifying levels of ink wear, soiling and/or damage that would deem a banknote unfit, increasingly banknote sorting frameworks (and by extension local recycling frameworks) are detailed technical specifications providing precise instruction for machine calibration and fitness sorting. Moreover, several central banks, the ECB and NCBs of the Eurosystem being a notable example, have full schemes that include detailed equipment certification. Further details about the Eurosystem recycling legislation are covered in **"Annex G: Eurosystem recycling legislation"** on page 51.

5.2.3 Role of penalties

Central banks may set financial penalties for 'fit-in-unfit' banknotes returned to it, ie. notes that are fit for reissue which have been returned in an unfit note return. If these penalties are high, there is a risk that only the very poorest unfit notes are returned and marginal notes recirculated for extended periods to avoid the consequences of misclassification.

Some central banks such as the Bank of England go further by only sampling unfit deposits and bulk destroying notes without individual final authentication. In this case errors found (and penalties charged) are aggregated up, assuming that the sample processed is representative of the whole deposit. For example, if there was a penalty for finding a counterfeit and one was found in a 10% sample of a batch, a penalty based on 10 counterfeits (100%)

of the batch is applied. This encourages the commercial processor to ensure errors are identified before deposit at the central bank.

5.2.4 Use of incentives

Some argue that incentives motivate more than penalties. Australia has an interesting approach, mixing incentives with penalties. In 2006, the Reserve Bank of Australia introduced a Note Quality Reward Scheme (NQRS) that incentivises commercial operators to ensure banknotes are sorted to a high standard, with the potential receipt of penalties if standards are not met. Payments are made to the participating commercial banks that are party to the central bank's Banknote Distribution Agreement which are in turn usually passed on to the commercial bank's cash processor.

The NQRS includes a definition of different levels of 'quality' for banknotes, based on the absence or presence of defects such as tears, folds, and ink wear. This allows banknote quality to be quantitatively 'scored' and provides guidance to the banks about whether a banknote can be recirculated or returned to the Reserve Bank for destruction. The Reserve Bank samples quality-sorted 'fit' banknotes at cash depots and makes payments to the banks based on the assessed quality score of the worst 15% of the banknotes sampled.

Under the scheme the maximum payment that the Australian commercial banks can collectively receive is capped at A$15 million per annum, and in 2022/3 the Bank paid over A$14 million in rewards on A$3.7 billion worth of banknotes deemed unfit for recirculation and returned for destruction.

While the intent of the scheme was to ensure that processors invested in fitness sorting equipment, the payments were not directly linked to equipment acquisition; today payments are in effect an expected subsidy paid to the cash processor to undertake cash sorting.

5.2.5 Off-balance sheet arrangements

Off-balance sheet arrangements – which are described in detail in 'Implementing off-balance sheet arrangements' within **"Annex F: Considerations for developing an off-balance sheet or custodial inventory"** on page 50 – provide a means of minimising the cost of holding cash across the commercial sector by allowing cash owners to be credited with its value overnight, freeing them up to invest it in the overnight market.

Increasingly, the provision of these financial benefits is tied to other objectives to support efficient commercial sector cash recirculation and recycling.

Currently, schemes are usually restricted to covering centralised cash holdings in approved secure cash centre facilities and are not offered to branches, ATMs or other self-service devices. This is normally to ensure that the balances reported can be verified through audit and physical inspection. If cash management is organised to get cash to cash centres so as to benefit from the relief, this may be driving higher levels of cash transportation.

With an eye to more sustainable cash processing there are opportunities – utilising enhanced management information systems – to extend off-balance sheet arrangements and support more localised cash recycling.

BENEFITS OF SHARED CASH PROCESSING OPERATIONS

Off-balance sheet arrangements can also facilitate effective inter-bank cash trading where cash supply and demand can be met between institutions. Settlement can be carried out bilaterally but may be administered via the central bank using their real time or high value payment systems.

Where cash processing operations are shared with multiple banks outsourced to a cash management company, or where a cash utility is formed, inter-bank trading may be simple to facilitate by the physical movement of currency within a cash centre or in some cases by accounting and ledger updates where there are shared cash pools. Clearly, in these cases, there are significantly reduced carbon footprints with transportation largely eliminated. If trading still requires the transportation of currency between locations, time and costs are involved.

Organisations such as Geldmaat in the Netherlands and Vaultex in the UK are good examples of banks coming together to pool resources and optimise currency recirculation.

5.2.6 Control of CIT and management companies

CIT and cash management companies play a critical role in a country's cash cycle. Their roles vary from simple secure transportation to operators of the most sophisticated outsourced cash processing solutions. Companies such as Geldmaat in the Netherlands, SBV Services in South Africa, and Vaultex in the UK (each featured in the respective country case studies) play fundamental roles in their country's cash cycles.

In countries where the law requires CIT companies to be licensed, the licensing process allows obligations to be placed on the CIT. Where the cash is being moved and/or managed on behalf of a commercial bank, then the central bank can use its control of that relationship to reach CITs.

AUSTRALIA'S CIT CHALLENGES

In countries where transactional cash use is in decline and/or where branches and ATM numbers are also reducing, the business viability of some cash management companies is becoming a greater concern.

For example, in Australia – following extended Competition Authority evaluation – the two largest cash management companies merged in 2023 to form a single national company with an approximately 90% market share. Despite giving assurances to maintain pricing and service levels, the company has of late reached out to its customers for increased fees and support to maintain its business as a going concern. Collectively, the banks and some key retailers, through the Australian Banking Association and with central bank involvement, are now hastily seeking to ensure that effective cash distribution can be maintained. The Competition Authority is also now using its powers to ensure the obligations that allowed the merger are being fulfilled.

In the Netherlands, legislation is currently before parliament to supersede an informal Cash Covenant signed in 2022 that not only preserves cash access and acceptance, but also ensures the integrity of the cash supply chain. The legislation will require designated CIT firms (those delivering and collecting cash from 30% or more of all cash locations) to undertake a range of detailed reporting and to make various commitments to safeguard business continuity.

In the UK, while CIT companies are not under the direct regulation of the central bank, the newly introduced Bank of England Codes of Practice require recognised firms to meet various detailed reporting requirements, which include disclosing their third-party arrangements covering CIT activities.

5.2.7 Direct support to fill distribution gaps

In fully or partially decentralised cash systems, central banks may support commercial recirculation and recycling to make or keep it viable, as well as being a method of control.

Central banks may plug geographic cash infrastructure gaps by developing relationships with commercial sector operators, banks or cash management companies to provide additional currency stores. In some cases, these serve as emergency or contingency stores, while others undertake more comprehensive day-to-day cash processing.

For example, in South Africa the Reserve Bank closed a number of its regional cash centres and moved wholesale (bulk) cash processing activities to the joint bank owned cash management company SBV Services. These 'Tier 1' cash centres serve not only SBV Services and its direct customers, but other CIT companies who can withdraw and deposit at these facilities. To support the stock holdings the Reserve Bank also provides an off-balance sheet facility.

In 2022, Banque de France entered into agreements with two of the country's largest cash management companies to establish 16 SABs (stocks auxiliaires de billets). The cash stored in the SABs is calibrated to supply the region and to reduce the need for Banque de France services, limiting the number of cash movements to and from the central bank. Auxiliary coin depositories (DAMs – dépôts auxiliaires de monnaies), also located at CITs and supplied directly from the Monnaie de Paris (the French Mint) in Pessac, complete the system.

In Mexico, while coin can only be withdrawn or deposited at the central bank's six regional branches, for banknotes it utilises commercial sector correspondent banks in a further 34 cities to ensure banknote supply across the country. Working on behalf of Banco de México, the correspondent banks meet the requests for banknote deposit and withdrawals from other banks in their towns.

A number of the arrangements have been established during or following the COVID-19 global pandemic, recognising the need to ensure robust distribution and backup plans, particularly where lock down arrangements restricted regional or countrywide movements.

5.2.8 Interbank cash exchange

If banknotes travel a shorter distance and there are fewer intermediaries, then efficiency, security, and the environment benefit. Interbank cash exchanges allow surpluses to match shortages without returning the cash to the central bank. Depending on country legislation, such trading can be informal or bilateral or can be underpinned by formalised trading arrangements. Typically, these are administered by either the central bank or a banking association or payments company.

There are practical operational barriers to interbank exchanges. Highly efficient logistics processes through automation require:

- Standards for logistic units in transport and storage which leads to less variety of transport boxes and seal bags
- Standards for auto-identification and Electronic Data Interchange (EDI) along the cash supply chain.

The service portfolio associated with cash products and services must be aligned with packaging and identification standards, otherwise process complexity at the inter-banking level will

LEGAL CHANGES NEED TO BE ABLE TO OPTIMISE CASH RECIRCULATION

(Courtesy of Cash Infra Pro)

Although many central banks allow currency exchange between banks, few have regulations that are adapted to automated storage and retrieval systems. As a result, parties can struggle to do inventory checks and regular audits. Furthermore, CITs as outsourcing partners of banks can perform orders to transport cash between two banks or to transfer banknote and coin units between two physical vaults. But such transactions are mostly not defined for automated vaults, which prevents cash centre operators from investing in modern automated storage systems. This is just one example, and there are many others.

To achieve continuous processing of deposits from different customers on high-speed processing systems, banknotes from different sources must be pooled. The conditions for this have to be set up to simplify and regularise the storage and trading of cash from different customers. However, the commingling of cash funds requires a financial service provider licence of the responsible party. CIT companies usually cannot provide such licence because they do not meet the application requirements.

Depending on the cash cycle model, CIT companies operate the cash depots on behalf of commercial banks or manage Note-Held-to-Order (NHTO) vaults within delegated NCB schemes inside the Eurosystem. They act with an appropriate insurance under the coverage of a banking licence vis-à-vis banks. In all cases, the out-tasking party remains responsible for a regular monitoring and control of the outsourced services as specified in the respective service agreements. At the NCB level, the bank must implement and control corresponding policies.

It must be clear that NCBs can out-task central bank services, but not the responsibility for their original duties. The same applies to commercial banks when they outsource cash services to CIT companies. A qualified monitoring and control function remains within their area of responsibility.

The challenges of the cash industry in moving towards greater cash cycle efficiency are not unique; other industries and government authorities have similar logistical processes, use similar automation technique and systems, and therefore face similar regulatory and organisational obstacles.

have a negative impact on the overall performance between the involved cash stakeholders.

Addressing these challenges has underpinned the development of the GS1 standard that is used across the Eurosystem, and a modified version that has been adopted in the US.

5.2.9 Engagement and oversight

Some central banks only engage with the financial institutions that withdraw and deposit cash, others have much broader stakeholder engagement across the supply chain. Cash logistic companies may simply be transportation companies acting as agents for their commercial bank customers with little or no engagement with the central bank, or they may be deeply engaged cash management companies closely connected to the central bank. Given the complexities and changes to most cash cycles, wider and closer stakeholder engagement is probably needed.

Central banks may choose to work with banking, payments, and other industry bodies or work directly with commercial companies across the supply chain.

Given the intricacies of automated currency handling, from vending and ticketing machines through self-service devices and sorting equipment, it is essential that central banks work closely with their commercial sector counterparts to prepare for changes. Several central banks have established – and then continue to maintain – Industry Engagement or Outreach Programmes to facilitate broad stakeholder dialogue.

As cash use continues to evolve, greater market oversight may be increasingly necessary. This can be through informal and occasional dialogue or much more prescribed measures. In the UK, for example, the Bank of England has enacted its powers following changes to UK legislation and introduced Codes of Practice for Wholesale Distribution setting out detailed reporting to which firms covered by the code must adhere (see also page 17)..

5.3 CASH RESILIENCE AND THE IMPORTANCE OF DATA

As cash use continues to change, central banks, particularly those face changing circumstances, need to closely monitor the health of the cash cycle. Branch and ATM closures or consolidation present significant cash access and acceptance challenges and reduced transactional cash may make commercial cash handling operations less viable.

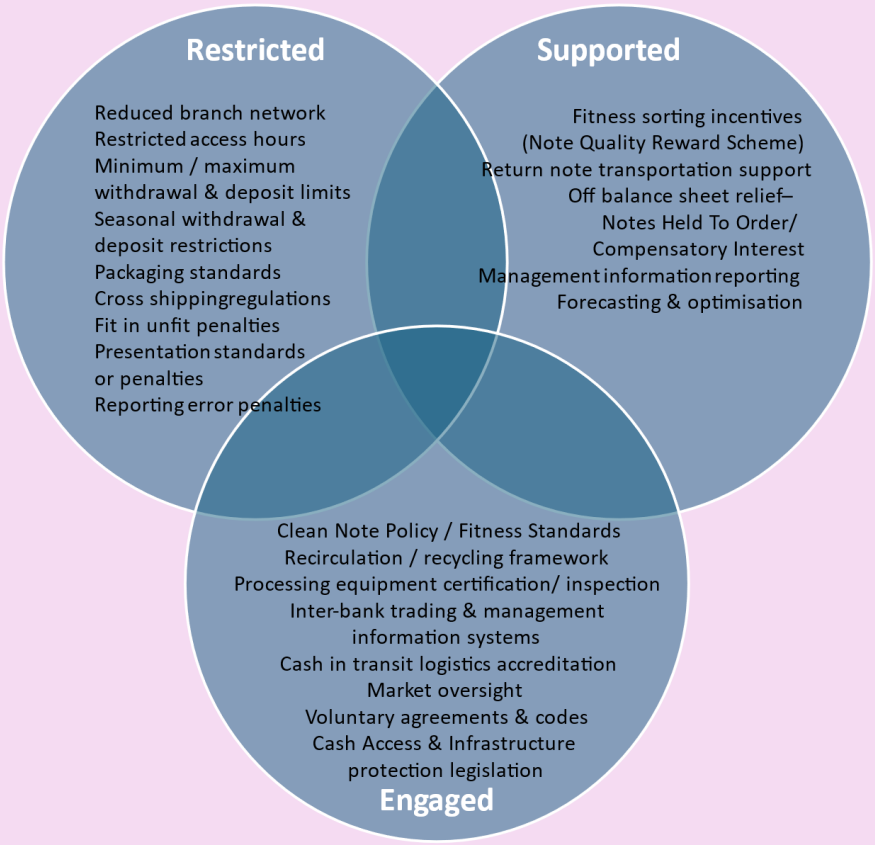
For forecasting and stock management, and to safeguard the viability of cash as a payment method, central banks need to have excellent data on what is happening to cash and a good understanding of the intentions and plans of stakeholders.

In decentralised systems most of this data lies outside of the central bank and so reporting requirements are placed on cash cycle stakeholders. Where there is a direct relationship, this is straightforward, eg. central bank to commercial bank, but where it is indirect life is more difficult, eg. central bank to a retailer. As the cash cycle changes, data held indirectly is becoming increasingly important and needed. This requires new thinking.

For direct relationships, central banks have developed extensive data management systems that can be used to support effective cash management and cash distribution. Standardised data in specified formats must be returned to the central bank to an agreed schedule. A failure to supply this data, which is often audited, can lead to fines or the suspension of licences. Increasingly this data is automated as part of a cash management system.

For example, in South Africa, an integrated cash management system (ICMS) automates the supply chain of wholesale physical cash at a national level, operated by BankservAfrica, the country's long-time clearing partner and official payment system provider. The system captures cash inventories for each participating bank, which in turn gives the South African Reserve Bank a national view of the volume and quality of circulating cash. The system handles cash orders at cash centres (from banks), inter-branch, bank client orders and inter-centre orders, provides for discrepancy handling and reconciliation, and enables automated interbank settlement of all cash transactions with the central bank's settlement system (SAMOS).

In Canada, the Royal Canadian Mint, working in conjunction with the National Coin Committee (NCC), financial institutions, and cash logistic companies, operates a coin recirculation scheme with its own software system managing stock levels, creating forecasts and ensuring effective coin recirculation across the country. More details are included in **"8.1 CANADA - ROYAL CANADIAN MINT: COIN RECIRCULATION AND RECYCLING"** on page 25.



Central bank levers, restrictions, penalties, support, incentives and engagement.

6. IMPLEMENTING OFF-BALANCE SHEET ARRANGEMENTS

While issuing banknotes (and potentially coin) is an opportunity to generate seigniorage income for the issuer, to the commercial banks, commercial cash handlers, and the public, currency in circulation is usually a non-interest earning asset. Unless an institution is required to maintain cash as part of liquidity reserve requirements there is an incentive – particularly in higher interest rate environments – to convert non-interest earning surplus cash balances into some other form of interest paying instrument. Historically, this would entail commercial banks paying in excess cash deposits at their nearest central bank branch on a frequent basis and similarly necessitated the frequent withdrawal of currency to meet subsequent demand.

In decentralised cash systems, commercial organisations can end up holding large stocks of surplus banknotes. While interbank trading can mitigate this, the theoretical response would be to return those notes overnight to the central bank so that the owner can invest the face value in the overnight market. If central banks have reduced their branch network, this is logistically difficult, and it is also recognised as non-value adding work.

The solution is to offer off-balance sheet arrangements to enable institutions to declare their surplus at the end of the day and to confirm that it is securely held in designated and approved premises as separated stock. The central bank then owns that currency and so credits the institution with its face value. The next day the stock is returned to the institution and their central bank account debited accordingly.

While the earliest arrangements were often simple agreements between scheme members, modern arrangements are increasingly complex, lay out in explicit detail the terms of the agreements, and are sometimes used by central banks to tie financial incentives to terms and conditions that support their overall currency issue and distribution objectives.

SEIGNIORAGE

In the modern context 'seigniorage' is the difference between the face value of banknotes and coin issued and their associated costs, sometimes simply production costs, but potentially also including the issuing authority's distribution costs.

Typically, a central bank will invest the face value received from issuing banknotes into circulation – knowing that at some point banknotes will be returned and redeemed – and the profit derived from these investments, net of associated currency costs, is considered seigniorage income.

Usually, net seigniorage income is paid over to the government, although in some cases gross income earned and expenses are accounted for separately. Given that, usually, the central bank will invest seigniorage proceeds in purchasing interest-yielding assets, and with a return to higher rates of interest, seigniorage income can be significant. For example, the Bank of England reported gross seigniorage income for the year ending February 2023 of £1.779 billion, associated operating expenses of £64 million, and a buffer of £34 million retained by the Bank, and therefore paid over a net £1.681 billion (equivalent to about US$2 billion) to the UK government.

6.1 BANK OF ENGLAND OFF-BALANCE SHEET SCHEME

An example of an off-balance sheet scheme is that of the Bank of England's Note Circulation Scheme (NCS). The first iteration of the scheme was developed in 1982 as the Notes-Held-to-Order scheme (NHTO). A Bank of England Annual report of the time stated that 'the clearing banks and other large users of notes have continued to co-operate in reducing the demand for new notes by drawing used notes when practicable. However, their increasing need for new notes for use in cash dispensing machines has had a marked effect on the drawings of such notes, particularly of £10 notes which doubled this year compared with last'.

By Christmas 1982, notes in circulation reached a new peak of nearly £12 billion and the Bank operated cash centres at its London Head Office, in five regional cash centre branches, and maintained its own printworks, in total employing almost 6,000 people across all activities. Today, currency is only distributed from London, the printworks has been outsourced to a commercial printer, the number of people directly involved in the currency function much reduced, and currency in circulation now stands at £82 billion. Over the 40 years the scheme has operated the number of banknotes on issue has tripled.

By 2001, note sorting was established as an activity wholly in the commercial sector and the NHTO Scheme was replaced by the Note Circulation Scheme (NCS). While the NHTO Scheme allowed certain institutions to hold banknotes on behalf of the Bank of England, the NCS is much more comprehensive, governing the distribution, processing, and storage of banknotes that are already in circulation. The Bank of England has progressively reduced its own banknote sorting activities to just the final authentication and destruction or sampling and destruction of unfit notes and the withdrawal and destruction of past series.

Over time various amendments to the scheme have been implemented, for example concerning security matters following a major raid on an NCS cash centre in 2006, and in 2010 some changes were made to support the improved distribution and circulation of the lowest value £5 note. The Bank is currently undertaking a detailed review of the scheme, allied to changes it is making to Wholesale Cash Distribution arrangements and its new legislative powers under the Financial Services and Markets Act 2023.

The current NCS has four direct participants – the government owned UK Post Office, the NatWest Group (the only British commercial bank to retain direct cash centre operations), and two cash management companies, G4S Cash Solutions and Vaultex UK.

The central bank has direct contractual arrangements with these four entities, although these agreements are underwritten and backed by supporting financial institutions. For example, Vaultex UK was formed in 2007 by UK commercial banks Barclays and HSBC, who merged their own cash centre operations to form the new business.

Combined with the Bank of England's April 2024 Wholesale Cash Distribution Codes of Practice – which extends beyond just NCS members – the Bank can use a mixture of financial incentives through its off-balance sheet relief and legislative powers to influence currency recirculation and recycling activities in the UK.

6.2 CUSTODIAL INVENTORIES / CENTRAL BANK OFF PREMISES HOLDINGS

An alternative to the development of off-balance sheet schemes, which underscore commercial cash handling operations, is the setup of central bank distributed contingency or strategic cash holdings. These are held at third party sites, with title to the currency being retained by the central bank until such time as the currency enters general use.

A good example here has been the United States Federal Reserve's global Extended Custodial Inventory (ECI) programme, first established as a pilot in 1996 to aid in the introduction of the then new currency design $100 banknote and since 2018 a part of the Federal Reserve's Foreign Bank International Cash Services Program.

The ECI programme serves to facilitate the international distribution of US banknotes, permit the repatriation of old design banknotes, promote the recirculation of fit new-design currency, and strengthen US information gathering capabilities on the international use of US currency.

The now well-developed programme has a set of stringent eligibility requirements requiring applicants to demonstrate a substantial commitment to the wholesale banknote business and their future involvement in the wholesale banknote market. In addition, applicants are subject to compliance and financial risk assessments and are required to submit to a range of conditions, including independent third-party audit and external reviews of their economic sanctions and anti-money laundering programmes. There are several ECIs in the major international banknote trading centres such as London, Frankfurt, Hong Kong, and Singapore.

In 2006, the Federal Reserve System introduced a domestic Custodial Inventory Program allied to the introduction of its Currency Recirculation Policy. The policy is intended to reduce overuse of central bank services, motivate recirculation best practices, and reduce the societal cost of

providing fit currency. The Custodial Inventory (CI) Program offers depository institutions (DIs) an incentive to hold currency in their vaults to meet customer demand and increase currency recirculation. An institution with CI status can transfer currency to the Federal Reserve Banks' books, but physically hold the currency within its secured facility, thereby reducing the investment cost of holding currency long enough to recirculate it to customers.

Currently, the CI Program is applicable only to $10 and $20 notes and under the programme an institution may hold in a CI up to four days average daily payments in $10 and $20 notes, provided it also holds one day of average daily payments on its own books.

As with the ECI programme, there are well documented procedures to become a CI Program member and maintain CI balances. The programme contains explicit requirements for the recirculation (referred to as cross-shipping) of banknotes that are part of the CI Program.

While initial schemes were more about reducing central bank cash handling activities, current schemes typically include features to ensure that they directly support and promote commercial sector recirculation and recycling activity.

For example, as above, the Federal Reserve's domestic CI Program only covers high transactional use $10 and $20 bills and expressly supports the active cross-shipping and recirculation of these banknotes within the commercial sector rather than through deposit and subsequent withdrawal at the central bank. Among a number of eligibility criteria, CI participants must be able to meet a minimum currency volume threshold by demonstrating that each vault in which they seek to operate a CI can recirculate a minimum of 200 bundles (200,000 banknotes) of $10 and $20 notes per week on a regular basis.

6.3 USING OFF-BALANCE SHEET SCHEMES TO MANAGE DENOMINATIONAL MIXES

Increasingly, central banks are using the leverage of their off-balance sheet schemes to influence the denominational mix in circulation.

For example, as part of its national cash management scheme, the South African Reserve Bank regularly meets with scheme members to review cash movement and recirculation data to ensure that there is an adequate range of banknotes, especially low denomination notes, in circulation. The central bank noted that, with the increased use of localised recycling, ensuring an appropriate denominational mix had become more difficult, with the local denominational mix available for withdrawal being highly dependent on the denominations deposited in the first place and on regular local replenishment.

Some schemes can include more formalised arrangements to support denominational mix. For example, as noted on page 21, the Bank of England made changes to its scheme in 2010 to specifically incentivise the sorting of £5 banknotes to support a push for greater ATM dispensing of its lowest value banknotes, which at the time were not being adequately distributed around the country.

There is often a financial incentive to fill ATMs and other self-service devices with high value banknotes to reduce the frequency and cost of replenishment. However, unless lower denominations are widely available, change giving becomes more difficult and may discourage acceptance of cash and drive consumers to other forms of payment. This is particularly noticeable in countries where cash use is in decline as digital payments grow, as merchants may only hold limited cash stocks and be unable or unwilling to give change for large denomination banknotes.

7. LOCAL RECYCLING

Local recycling of notes has always existed. Large retailers have invested in their own cash processing equipment and CIT companies have established local sorting close to their clients. Surplus stock has been used to supply ATMs, sold to those needing notes, or returned to cash centres/banks.

As commercial banks withdraw from communities and as automated cash handling has increased in the form of retail equipment that accepts cash deposits and issues change, Smartsafes linked to shop tills etc., local recycling is increasing.

Equipment exists that combines banknote recycling for a broad range of denominations with coin functionality (dispense and deposit), providing the broadest use possible and capable of filling gaps where full-service branches are closed. While traditionally focused on supporting personal customers, suitably scaled self-service devices can also meet local small business and retail cash deposit needs and introduce additional deposit sources to support overall recirculation.

While central banks have varying degrees of control over organisations running ATMs networks and CITs, their control of retailers and businesses is significantly less and data gathering rare. This is both a challenge and an opportunity.

7.1 THE BENEFITS AND DISADVANTAGES OF LOCALISED RECYCLING

Localised recycling has the potential to significantly reduce the frequency of cash movements. Commercial banks that have deployed extensive localised recirculation have reported reduced transportation of more than one third and reduced centralised cash processing by up to two thirds.

However, a challenge exists when there is a significant disparity between cash deposited and cash withdrawn, for example if many large notes are deposited, but mainly small notes withdrawn. This may make local recycling sub-optimal. ATMs require specific denominations and there is always the risk the local system won't supply them.

7.2 RECYCLING AND AUTOMATION AT THE RETAIL STORE LEVEL

Local recycling is not limited to bank branch and remote ATM sites, but is increasingly seen as a part of retail POS solutions. This can potentially be coupled with cash out or cash back at the retailer – especially in large supermarket locations – which could reduce retailer cash banking and cash transportation costs and, depending on the merchant acquiring arrangements, may also be beneficial from a merchant card fees perspective.

UK CASE STUDY

A UK commercial bank introduced local recycling in its network in 2018, driving efficiency by reducing CIT requirements by around 40% and reducing notes into the cash centre by 90% (notes that were handled in the branch network).

Local recycling

The bank introduced Glory machines (USF300s and 200s) and so could fitness sort and authenticate notes ready for reissue. Notes also taken in through the bank's Deposit Teller Machines/Teller Cash Recyclers could also be fitness sorted, counted, and reissued.

Part of the evaluation to do this included checking that the additional work to fitness sort the notes was balanced or more than balanced with less time managing CIT deliveries, which it did, and ensuring cash levels in branches did not get too high. Equipment is updated when new notes come out.

Local versus central note processing

For deposits it found that central processing at its cash centre was the most efficient place, partly because this is a requirement under the rules for the return of unfit notes and partly because the bank has a deficit of A fit notes, ie. suitable for ATM issue. The balance between local recycling and cash centre processing is based on these factors and anything coming into its branches that is handled by the staff is managed locally, with any customer drop box money and additional cash requirements coming from the cash centre. There is no coin recycling capability – therefore excess coin and coin requirements come from the cash centre.

As cash use diminishes this bank will balance between local recycling and cash centre processing. The bank thinks it unlikely that cash use will decline to the point where deposits could be managed locally.

There are a number of Fintech cash enabling companies (sometimes dubbed Cashtech), such as Swiss-based Sonect and Germany's Barzahlen/Viacash, that link consumers requiring cash but without easy access to a traditional ATM through a mobile phone-based app. This identifies retailers that can fulfil the withdrawal from their cash takings at till. These innovations truly localise the cash supply chain, reducing the carbon footprint of cash to a minimum. These apps can be standalone or integrated into the customer's banking app, offering seamless local cash withdrawal facilities.

7.3 CAN LOCAL RECYCLING BE GIVEN OFF-BALANCE SHEET TREATMENT?

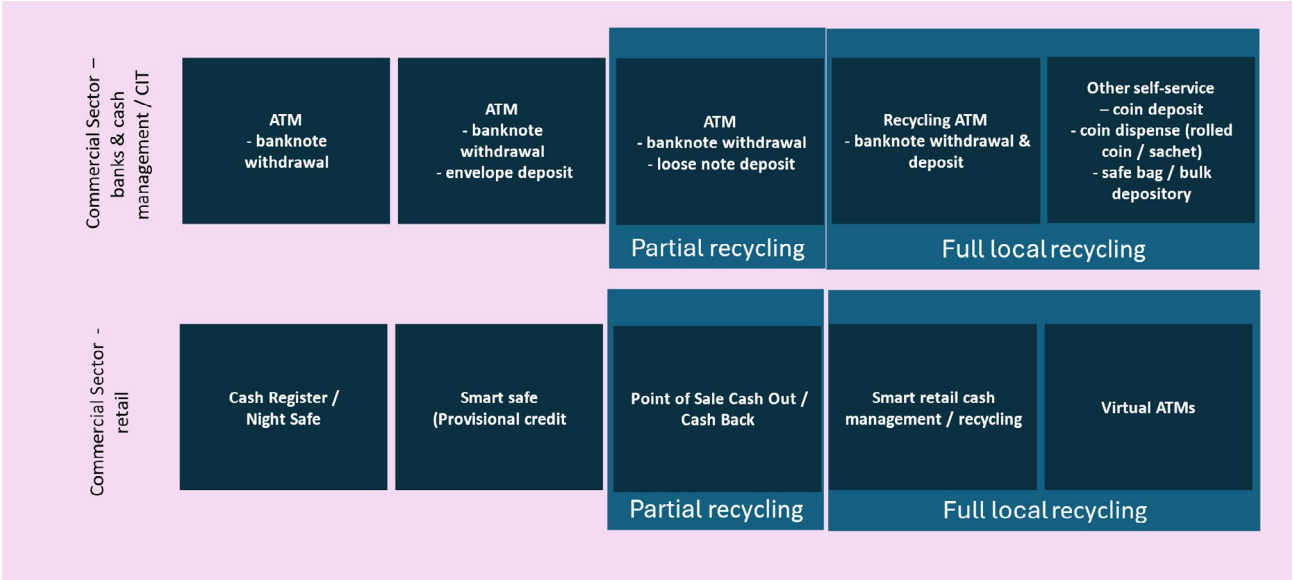
As described, the origins and intent of most off-balance sheet schemes have been to reduce currency movements to and from central banks, which accounts for a significant proportion of the cash supply chain's environmental impact.

Off-balance sheet schemes require cash to be processed and securely held at designated centralised sites. In countries where transactional cash use is in decline, this may entail consolidation of cash processing locations – either for individual organisations or where economies of scale dictate merger and shared processing – resulting in fewer centralised processing locations and cash being moved over greater distances with consequent negative environmental impacts.

The logical progression of this is perhaps to extend off-balance sheet arrangements beyond centralised processing sites to local cash recycling devices – be that ATM recyclers or other cash recyclers in the commercial sector.

This does give rise to a whole range of considerations as to how to account for and, if required, physically audit a potentially much greater number of cash holding points. It also significantly moves the line between wholesale or bulk cash handling – which central banks often seek to support from an infrastructure and societal point of view – and much lower-level retail cash handling, with an array of associated competitive and commercial considerations.

Banking and retail recycling technology



8. COUNTRY CASE STUDIES

8.1 CANADA - ROYAL CANADIAN MINT: COIN RECIRCULATION AND RECYCLING

In Canada, the Royal Canadian Mint, unlike many other mints, is not only the manufacturer of circulating coin, but also the country's end-to-end coin lifecycle manager. On behalf of the Department of Finance of the Government of Canada, the Mint has taken on a much broader role across the coin ecosystem. In addition to coin design and production, the Mint also engages in coin forecasting, distribution, recirculation, recycling, and monitoring to ensure an efficient and sustainable coin supply chain.

Before introducing the coin management system over 20 years ago, Canada faced difficulties in inefficient coin circulation, which included no clear view of the coin ecosystem, periodic shortages or excessive inventories, lack of commercial stakeholder collaboration, and production challenges. The Royal Canadian Mint set out to work with the commercial sector to design a more efficient and sustainable solution for coin management.

The system is one that has been continuously refined over the years, to help transform the Canadian coin ecosystem and resolve these earlier supply chain challenges.

In the early 2000s, the Mint, collaborating with financial institutions and armoured car companies, developed a proprietary system to capture coin stock holdings across the country. With sight of all coin stocks the Mint is able to produce weekly automated forecasts to identify surplus coin holdings. Forecasts are produced to a very granular level, with some 26,000 individual forecasts created each year, identifying coin requirements at an institution, location, and coin denomination level.

The efficiency of the system has achieved a significant reduction in excess coin manufacturing. In 2023, the Mint met 88% of the demand by recirculating existing coin inventories (1.8 billion pieces). The balance of demand was met by newly minted coin (248 million coins). The system's flexibility, and trust in it by its participants, has also ensured that challenges to Canadian coin distribution in times of adversity, such as during the Global Financial Crisis or COVID-19 pandemic, have been kept to a minimum.

Not only does the Mint produce the forecasts, but it instigates the trades and oversees the efficient movement of surplus stock to meet demand. As the trusted manager of the system, competitive financial institutions and armoured car companies closely collaborate with one another to ensure effective coin distribution and recirculation.

Working through the auspices of the National Coin Committee (NCC), the Mint, together with the NCC financial institution and armoured car company members, has developed – and over time continues to refine – a series of guidelines, procedures, processes, and rules to ensure efficient coin trading and recirculation. The Mint oversees and audits adherence to the scheme and also provides regular score cards to report on member performance – for example, the timeliness of the transfer of coins following trading.

The NCC meets twice a year to discuss issues, developments, and trends that are impacting coin and cash use. The Mint also engages closely with the Canadian public and businesses to ensure that it keeps abreast of changing attitudes and behaviours toward coin use.

According to 2023 research by Payments Canada, the majority of Canadians (55 %) say they have no desire to go cashless. The research concluded that 'cash is seen as a reliable, widely accepted, safe and secure payment option that Canadians do not want to live without'.

This reliability is in no small part due to the efficiency of the Royal Canadian Mint's end-to-end coin management system.

8.2 MEXICO – BANCO DE MEXICO: PLAYING A CENTRAL ROLE IN CASH MANAGEMENT

Mexico is home to just over 130 million people, a quarter of whom live in and around Mexico City. With just under half of the adult population banked (49% in 2022) cash use remains significant, albeit gradually declining as other payment methods gain popularity.

The central bank, Banco de México, is responsible for the printing of currency at its two printworks, while the Casa de Moneda de Mexico, the Mexican Mint, produces the country's coin. The central bank is responsible for both banknote and coin distribution and does this through its Regional Cashiers and working with commercial banks that act as correspondent banks in 34 cities across the country.

Banknotes are distributed across the Bank's Regional Cashiers and the commercial correspondents largely using the central bank's own transportation fleet, which includes 19 armoured vehicles and two of its own planes. The Mexican military provide escort services

where necessary. Coin distribution is restricted to the six Regional Cashiers, with coin demand in other areas met from the Regional Centres using commercial cash logistics companies.

The central bank issues new currency and accepts currency provided it has been sorted into fit and unfit. It allows the recirculation of fit currency, with any of the commercial banks able to deposit and withdraw at the commercial correspondent cash centres. The central bank publishes guides to categorise unfit currency but does not formally set out to administer specific technical specifications.

All high denomination banknotes (200 pesos or more) are authenticated before final destruction, with lower denomination notes sample checked. If the sampled banknotes fail to meet the classification standard (fit or unfit) the whole deposit is rejected. This requires the commercial bank to collect, re-process and re-deposit the notes, the cost of which encourages accurate classification in the first place.

The central bank does not – and does not intend to – operate an off-balance sheet arrangement, but depositing banks are given immediate credit for depositing at any of the correspondent bank cash centres or at the central bank's own offices.

Using a proprietary management information system, the Banco de México monitors currency stock levels across all locations so that it can forecast currency production and distribution. Banks also use the system to notify the central bank of cash orders, but are free to undertake their own interbank trading, or movements.

The central bank also actively manages the mix of banknotes and coin in circulation, meeting counterfeit threats with new and improved designs. For example, in 2020, faced with increased counterfeit levels, the bank introduced a new highest denomination 1,000 peso note (about US$60). The bank specified targets for the commercial bank recall of the old series notes, leading to the full withdrawal by 2023.

8.3 NETHERLANDS – DUTCH NATIONAL BANK

1996	11 Dutch National Bank branches (reduced to a single head office site by 2009)
2002	Netherlands joins 11 other countries in Europe, replacing the Dutch guilder with euro banknotes and coin
2006	ABN AMRO and Rabobank pool cash centre infrastructure to form Altajo BV
2011	ING joins ABN AMRO and Rabobank, renaming Altajo to form Geldservices Nederland (GSN)
2017	McKinsey study for GSN on ATM pooling
2019	GSN renamed Geldmaat and the 3 bank ATM networks merged
2021	The Future of the Cash Infrastructure in the Netherlands – McKinsey study for Dutch National Bank and National Forum on the Payment System (NFPS)
2022	Covenant Contant Geld – voluntary Dutch Cash Covenant signed (7 April 2022)
2023	Future market design of the Dutch cash cycle (PwC) for Dutch National Bank and Ministry of Finance
2024	Cash Payments Act – draft legislation introduced by Ministry of Finance (26 January 2024)

8.3.1 Country overview

Now one of 20 European countries that share the euro single currency, the Netherlands cash ecosystem has evolved considerably over recent years. Over time, the Dutch central bank, known as the Dutch National Bank (DNB), has reduced its operations, outsourcing most cash recirculation activities to the commercial sector.

Despite its more limited physical involvement in the cash cycle, DNB has maintained an active role in ensuring that cash remains an effective means of payment. DNB regularly undertakes detailed research to understand market conditions, especially monitoring cash access and availability and is particularly concerned in understanding the needs of vulnerable groups that are highly reliant on cash.

DNB has also in recent times commissioned two major independent consultancy studies, the first in 2021 in conjunction with NFPS where McKinsey undertook an analysis of the Future of the Cash Infrastructure in the Netherlands. Subsequently, in 2023, with the Ministry of Finance, the Bank asked

Strategy&, part of the PwC network, to complete a study on the Future of Cash Supply Chain.

Outcomes from the first study led to a voluntary cash covenant between the Bank and 22 organisations with an interest in cash. The second study concluded that these voluntary arrangements were not in sufficient in the long term to safeguard the cash cycle and legislation is now before the Dutch government to introduce a Cash Payments Act.

8.3.2 The role of the central bank

DNB, established in 1814, is a now one of the NCBs of the Eurosystem. Once operating four cash centres around the country, since 2023 DNB has managed its cash and gold operations from a purpose-built cash centre located on a military compound near the town of Zeist.

While retaining new currency issuing and final authentication and destruction, day-to-day recirculation has progressively moved to the commercial sector. As cash use has diminished and access to and acceptance of cash has also reduced, DNB has focused on overseeing the effectiveness of the country's cash ecosystem.

As in many countries, the COVID-19 pandemic and its movement restrictions and reduced retail activity saw significant reductions in cash use. For some years DNB has been a net receiver of euro banknotes, with inbound business and tourism bringing euros issued elsewhere in the Eurozone into the country. Commercial banks deposited these at a higher rate than DNB needed to issue new notes. In 2020 tourism fell by 65% and deposits quickly diminished. With a sharp rise in cash demand for largely precautionary purposes, DNB reversed its long-term trend to become a net issuer of euros.

8.3.3 Commercial sector cash handling

Dutch commercial companies play an active part in the recirculation and recycling of cash.

In 2006, two of the largest Dutch Banks – ABN AMRO and Rabobank – combined their cash centre operations to form a joint venture called Altajo BV. By 2011, a third bank ING joined the joint venture, and the company was renamed Geldservices Nederland (GSN).

With shared cash logistics established, but cash activity already in decline, the shareholder banks employed consultants to evaluate the potential of merging each bank's ATM network. GSN was renamed Geldmaat in 2019 and the three bank ATM networks were duly merged. Through consolidation and other bank ATM closures the number of ATMs in the Netherlands had fallen from 8,356 in 2010 to 5,297 by 2020.

Branch numbers also declined significantly over the same period – from 2,864 to 942.

The Netherlands has a highly concentrated cash logistics marketplace, with the decline in cash use leading to consolidation in the CIT market. In 2010, there were three large CIT companies: Brinks, SecurCash, and G4S. Of the three, only Brinks remains and now has a more than 90% market share. Following the collapse of a smaller operator in 2022, German cash logistics company Ziemann has established a Dutch operation with a growing – but still a minority – market share. The dominance of a single cash logistics company presents significant market concentration risks, in part mitigated by the 2022 voluntary Dutch Cash Covenant.

8.3.4 Voluntary Dutch Cash Covenant

Recognising the decline in cash access and acceptance, as both the number of bank branches and self-service devices declined, and the potential fragility of the cash logistics sector, in April 2022 the DNB secured a voluntary arrangement or 'Covenant' bringing together 22 organisations – commercial banks, cash logistics companies, and other cash stakeholders in the Dutch cash ecosystem.

The agreement acknowledged that an efficient, accessible and secure payment system, including cash, was essential. The Covenant set out minimum cash access and acceptance and infrastructure requirements, sought specific assurances from Brinks as the main cash logistics provider, and sought assurances on cash service pricing. Participants also committed to develop new forms of payment and alternative fallback options for debit card payments.

For example, the Covenant specified that a minimum of 3,850 ATMs for cash withdrawal be accessible to 99.76% of the population within a distance of 5km. Other specifications detailed the number of depository devices for both loose and bag deposit, coin withdrawal and deposit devices and that at least 200 ATMs would be required to dispense the lowest denomination €5 banknote. The agreement also specified minimum availability levels for these devices.

While the Dutch Cash Covenant was welcomed and put immediate breaks on further reductions in cash access and acceptance, the agreement was only voluntary. There was no legal obligation to maintain infrastructure and no party with formal supervisory or sanctioning powers for non-adherence.

8.3.5 Study on the Future of the Dutch Cash Supply Chain

In 2023, to address the need for a long-term solution, DNB and the Ministry of Finance commissioned advisory firm Strategy& to undertake an updated review of the Future of the Dutch Cash Supply Chain.

The detailed study looked at a series of options to ensure the future resilience of the supply chain. Recognising that a voluntary arrangement was unlikely to guarantee long-term access, acceptance and supply, three options were considered.

1. To establish legal requirements and safeguards for cash that payment account providers must follow
2. To establish a Universal Cash Services Provider that provides cash services to all
3. For the government to directly intervene and manage the provision of services and thus have more control over quality.

Each option was considered in detail, evaluating how it might operate, which organisations would be obliged to participate and how each model would be funded, including by potentially raising a levy on electronic transactions. Given that the Netherlands is a part of the Eurosystem, careful consideration was given to policies and practices in other countries and how any solutions might be interpreted in the broader European context.

8.3.6 Cash Payments Act

Following the review, it was concluded that while options 2. and 3. provided the greatest degree of certainty and control, they would come with the highest societal costs, require significant changes to current arrangements, and that the government itself does not have the necessary skills and experience. It was therefore concluded that establishing legal safeguards was the preferred route and a Cash Payments Act was presented before Parliament in January 2024.

The legislation sets out the requirements for commercial banks that have more than 3 million Dutch resident account holders to maintain agreed basic infrastructure for cash withdrawals and deposits that are accessible to their customers and to those of other banks. The Act also sets out obligations and arrangements for CIT companies of either regional or national scale.

The Act requires that DNB designates companies that will then have regular reporting obligations so that it can closely monitor their health and viability and intervene if required to ensure market stability.

8.4 PHILIPPINES – BANGKO SENTRAL NG PILIPINAS: CASH SERVICE ALLIANCE & COIN DEPOSIT MACHINE PROJECT

The Philippines comprises around 7,640 islands — about 2,000 of which are inhabited — and form an archipelago that is home to over 118 million people, of which just over half the adult population have formal banking facilities. As such, currency – both banknotes and coin – remains a vitally important means of payments. But given the geography of the country, distribution of currency is challenging.

As in many countries, these challenges were exacerbated by the COVID-19 pandemic. Stringent measures taken by the government to limit the risk of the disease spreading involved the suspension of public transport and closure of non-essential businesses. The restrictions were particularly acute in the nation's capital, with the Greater Manila region being home to about a quarter of the country's population.

By October 2020, faced with major cash distribution problems, Bangko Sentral ng Pilipinas (BSP), working with the Bankers Association of the Philippines, established a Cash Services Alliance (CSA). The BSP established procedures, processes and developed an in-house reporting system to match commercial bank excess cash stocks with other commercial banks needing fit banknotes or coin.

The guidelines, issued in a central bank circular, set out the recirculation arrangements, encouraging commercial banks to match supply and demand in preference to drawing or depositing from the central bank. Deficit 'Client Bank' and surplus 'Source Banks' input their requirements and available fit stock levels into a secure reporting system established by the BSP.

Participating banks – 28 of the 31 commercial banks in Manila joined the Alliance – were required to establish bilateral agreements to support inter-bank trading based on a set of parameters laid out by BSP. Rules were established as to when stock availability and order requests were to be reported, and procedures for matching stock if matches were not made; the central bank continued to allow deposits or withdrawals if required from the central bank. The BSP also set out specifications for currency quality and standardised packaging, in addition to prescribing settlement and dispute resolution procedures. Banks were encouraged to settle through the country's Real Time Gross Settlement System, but alternatives were also provided.

The award-winning initiative proved extremely successful; in the first seven months of operation 147 million banknotes were supplied through the

CSA arrangements, equivalent to over half the number of all banknotes required. By the time of a second lockdown in late March to May 2021, use of the CSA trading arrangements satisfied nearly all commercial bank requirements.

Because of the successful response to the pandemic restrictions, the Cash Supply Alliance has been extended countrywide. Updated BSP guidelines published in April 2021 set out the expansion of the trading arrangements to the central bank's next six largest regions in June 2021, with the remainder of the country covered by year end. Trading and commercial sector recirculation outside Manila has been a little slower to take off, but volumes are now starting to grow.

While the Cash Services Alliance has supported significantly greater recirculation, coin recirculation and consistent stock availability for change giving remains problematic. To tackle these challenges, BSP has established a trial working with two cash management companies to deploy Coin Deposit Machines. The trial, launched in June 2022, has seen the setup of 25 coin depository devices located at three participating retailers across the Greater Manila Area. In the first year over 194 million coins were recovered with more than 175,000 customer deposits made.

Consumers can pay in their loose coins, which are sorted and counted by the device. Foreign or invalid coins are rejected and returned. The value of the coins can be credited in real time to a digital wallet GCash, which in turn can be linked to local bank accounts, used for domestic remittances using GCash Padala, or accessible at one of more than 72,000 ATMs and GCash Partner Outlets. Alternatively, depositors can obtain a shopping voucher to use at the participating retailers. In either case consumers receive full value for their coin deposits, with no fees charged.

In return, BSP can recover coin that might otherwise be lost, improve localised coin supply and reduce new coin production needs. Connectivity to a digital wallet is also seen as a stepping stone to greater financial inclusion. The central bank plans to evaluate the trial in due course.

8.5 SOUTH AFRICA – SOUTH AFRICAN RESERVE BANK: MANAGING CASH IN A HIGH-RISK ENVIRONMENT

1986	**Shared bank owned cash management company SBV established**
1995	**SARB introduces NHTO scheme**
2008	**Integrated Cash Management System established**
2017	**SARB closes 3 regional branches and convert 3 to cash centres (closing public counters)**

8.5.1 Country overview

Notwithstanding increased levels of financial inclusion in recent years and a sophisticated banking sector, cash remains the dominant means of payment in South Africa. Government analysis[3] estimates that at least 91% of South African adults have been formally included in its financial system, of which 81% have a bank account, 78% use other non-bank channels, and approximately 61% still use informal channels. However, the government has concluded that the ways in which financial services are utilised, as well as ongoing inadequate access to certain financial services, remain problematic.

University of Pretoria research[4] commissioned by cash management solutions company SBV Services revealed that for over half of lower income earners, cash remains the number one payment method in most payment categories, including for the essentials of day-to-day living such as food, electricity, transportation, and communications (airtime and data). Cash also remains important for more affluent consumers and research revealed that, despite growing digital adoption, 64% of all South Africans have expressed a future cash preference.

With large income disparities, South Africa has very high – often violent – levels of crime. This has significantly shaped the way in which cash is managed in the country, with cash security and managing cash stocks conservatively a keen focus across the supply chain.

8.5.2 The role of the central bank

The South African Reserve Bank (SARB) is the country's sole issuing authority of banknotes and coin, with printing and minting being undertaken by the Bank's wholly owned

3 South African National Treasury Financial Inclusion Policy Framework for South Africa, 'An Inclusive Financial Sector for All', November 2023.

4 SBV South African Research Paper – Study conducted by the University of Pretoria, October 2023.

subsidiaries, the South African Banknote Company and the South African Mint Company respectively. Both companies are pursuing a range of sustainability and cost efficiency initiatives, for example the Mint is a founding member of the Sustainability Subcommittee of the Mint Directors Association (MDA).

The central bank maintains a main note store adjacent to its printworks and from there distributes currency to its regional cash centres. In recent years it has reduced and rationalised its branch network, moving greater distribution and cash processing responsibilities to the commercial sector. SARB now retains just three cash centres – in Cape Town, Durban, and Johannesburg.

To support commercial sector engagement in the cash supply chain, SARB has a longstanding off-balance sheet NHTO arrangement, first established in 1995.

This ability to hold designated currency stocks off-balance sheet has been integral, alongside the central bank's collaborative and highly consultative approach, in moving large parts of its distribution and cash handling functions to the commercial sector.

8.5.3 Commercial sector cash handling

Pre-eminent amongst the commercial sector cash handlers in South Africa is SBV Services, a cash management and cash logistics company established in 1986 and jointly owned by four of South Africa's largest commercial banks – ABSA, First National Bank, Nedbank, and Standard Bank.

SBV operates what are referred to as Tier 1 and Tier 2 cash services and secure cash centres.

Tier 1 cash centres are considered 'industry essential' bulk distribution and wholesale processing facilities operating on behalf of SARB and covered by the NHTO arrangements. SBV Tier 1 cash centres serve as distribution points for other bank and CIT operators as well as distribution points for SBV's own bank and retail cash operations. These include servicing bank branches, over 8,000 ATMs, and some retailers directly, using a fleet of more than 1,000 CIT and support vehicles.

Tier 2 cash centres are typically smaller processing or distribution points focused on supporting local bank branch and retail customer cash needs. SBV operate over 30 cash centres with, in many cases, Tier 1 and Tier 2 centres being co-located to minimise physical movement of cash between wholesale and retail operations.

From its origins simply as a means of sharing and optimising the cash transportation arrangements of its then three, later four, bank shareholders, SBV has evolved into a sophisticated cash management company that is integral to the smooth functioning of the South African cash supply chain.

For example, it now manages all aspects of coin distribution from initial supply from the South African Mint, tasks formerly undertaken by SARB. Its significant role presents some market concentration risks, but this is mitigated by the strong ownership structure of the company.

That said, both SARB and the individual banks are pursuing various initiatives to work with the other major CIT companies to ensure a robust, competitive, and sustainable cash marketplace. Fidelity Cash Solutions, part of the Fidelity Services Group, and international cash management company G4S also operate a number of cash centres across the country. To support competitiveness and resilience, SARB has recently extended NHTO status to a few of these cash centres. Of the major banks, only First National retains its own cash centre operations.

The South African cash landscape remains vibrant and active given continued heavy cash use, both as a payment method and as a backup means of payment in response to technological failures or frequent system outages.

Cash forecasting and optimisation practices are advanced, with the focus firmly on managing cash holding levels from a risk viewpoint rather than simply from a cost perspective. Whereas in other countries there may be a focus to minimise transportation costs, the value of cash held and its risk of theft weigh heavily in the cash management decisions that play out.

Supporting cash forecasting and optimisation, BankservAfrica (another company established, and majority owned, by four of the big banks) operates an integrated cash management system (ICMS) that automates the supply chain of wholesale physical cash at a national level. The system tracks, streamlines, and reconciles the movement of cash between bank branches, different banks, cash centres and CIT services, and ultimately settles those cash transactions with the central bank.

8.5.4 Incentives and penalties

SARB has a number of incentives and penalties to help influence commercial sector cash handling behaviour. Chief amongst this is the provision of NHTO off-balance sheet relief. SARB meets with the banks that are party to the scheme on a monthly basis, exchanging a range of data that not only monitors cash holding levels but flows of cash and, importantly, the denomination mix of currency being circulated.

SARB uses this as a lever to control the level of high value notes and support the circulation

of lower value notes being distributed to ensure the public has access to the full range of denominations they need. Banks and cash management companies are required to forecast demand to assist SARB in its own currency demand planning and it has the ability to penalise if forecasts are outside agreed tolerances.

8.5.5 Banknote fitness and recycling

Unlike some central banks that have established specific cash processing equipment certification schemes, SARB has taken a novel and collaborative approach towards the industry.

Taking its own high speed banknote sorting equipment as a benchmark but recognising that not all commercial cash handling equipment is as sophisticated, SARB has established a general fitness standard in collaboration with the cash industry. Notes must be sorted to within agreed tolerances and if not done so are subject to penalty. The central bank has a Note Fitness Inspectorate team that plans, controls, coordinates, and conducts quality inspections and audits at cash centres around the country.

Localised cash recycling is becoming more prevalent with the introduction of recycling ATMs. SARB has observed that while technical standards for quality can be controlled, it is much harder to ensure a consistent and appropriate mix of denominations available to dispense as this is largely dependent on the banknotes being deposited.

8.5.6 Looking to the future

Although already very forward thinking and collaborative, SARB is not resting on its laurels and is currently embarking on an end-to-end supply chain review to ensure efficiency in all parts of the cash cycle, from printing and minting to the end consumer and back.

It is also reviewing its current policies and processes, recognising that many of these have been prescribed over a number of years and that the cash environment is ever changing. The intent is to identify policies or procedures that may no longer be appropriate or applicable.

Looking to the future, while digital uptake and financial inclusion grow, there is likely to remain a strong need for efficient and effective cash distribution. Anecdotally, welfare recipients (South Africa has one of the world's most expansive social grant systems with an estimated 47%[5] of the population receiving a monthly grant) will often withdraw their digitally paid grant from an ATM or bank branch in cash and then use this during the course of the month to budget, negotiate on food and other staple purchases, and to avoid further bank charges associated with digital transactions.

5 South African Social Security Agency (SASSA), Annual Performance Plan 2022-2023.

8.6 UK – BANK OF ENGLAND: THE EVOLVING CASH MANAGEMENT ROLE OF A CENTRAL BANK

1967	World's first ATM opened at Barclays Bank, Enfield in North London
1982	Bank of England (BOE) NHTO scheme established
1985	Association of Payment Clearing Services (APACS) established, industry liaison Cash Services Group established
1985	LINK UK ATM network and world's busiest ATM switch established
1997	BOE Birmingham, Bristol, Manchester & Newcastle branches closed
2001	NHTO replaced with Note Circulation Scheme (NCS), banknote sorting fully outsourced to commercial sector
2004	BOE deposit standards introduced, 'fit-in-unfit' penalties introduced
2006	Robbery of Securitas operated cash centre, £53 million stolen
2007	Barclays Bank and HSBC merge cash centre operations to form Vaultex UK
2008	Association of Commercial Banknote Issuers formed to represent the interests of the seven (now six) Scottish and Northern Ireland banknote issuing banks
2010	NCS scheme changes to support £5 distribution initiatives
2013	Code of Conduct for the Authentication of Machine-Dispensed Banknotes introduced
2018	Access to Cash Review established
2018	Future Cash Supply Chain Working Group (FCSCWG) established
Feb 2019	Access to Cash Review published as final report
May 2019	UK government chaired Joint Authorities Cash Strategy (JACS) Group established
May 2019	BOE chaired Wholesale Distribution Steering Group (WDGS) established
Dec 2021	WDSG publish decision not to proceed with a utility but, instead, to agree industry-wide and individual firm actions to support the UK cash infrastructure
Feb 2023	Last remaining regional BOE cash centre in Leeds closes
Jun 2023	Financial Services and Markets Act 2023 enacted, BOE receives new market and prudential oversight powers over the UK wholesale cash distribution market
Apr 2024	BOE publishes Codes of Practice for market oversight and wholesale cash distribution data catalogue

8.6.1 Country overview

The UK has a highly outsourced cash cycle that has developed over many years. Sterling banknotes are issued by the Bank of England (BOE) and printed under contract by commercial printer De La Rue at the BOE's former printworks near London. In addition, three Scottish and two Northern Irish banks retain historic rights to issue their own banknotes. The Royal Mint is the sole supplier of circulating coin for the United Kingdom. Coins are produced at their mint in South Wales.

While cash in circulation on issue is at its highest ever value (£82.4 billion, or ~US$104 billion, in 2024) transactional cash use has declined significantly. According to research by UK Finance, noted in their UK Payment Markets Summary, the number of cash payments declined from 17.2 billion in 2015 (45% of all payments) to 6.4 billion (14% of all payments) in 2022.

8.6.2 The role of the central bank

The Bank of England was one of the first central banks to devolve most of its cash processing to the commercial sector, having introduced an NHTO sheet scheme to support commercial sector banknote recirculation more than 40 years ago.

Today, the central bank issues new currency and accepts unfit or old series currency for final authentication and destruction. All day-to-day recirculation of currency is undertaken in the commercial sector by a range of organisations.

Set against a substantial decline in transactional cash use and also significant decline in bank branch numbers – which is creating cash access and acceptance challenges – the BOE has continued to reduce its physical involvement in banknote handling, closing its last regional cash centre in Leeds in 2023. While limiting physical cash processing, the Bank plays an active role in system supervision. Supported by UK government legislation (the Financial Services and Markets Act 2023), it has significantly strengthened its market oversight and supervisory controls of the cash cycle.

As early as 1982, the BOE, faced with demands to support the UK's burgeoning ATM network, introduced an off-balance sheet arrangement that enabled commercial banks to hold surplus banknotes on their premises, but without having to carry these on their own balance sheets. The value of these banknotes was credited to the commercial bank's settlement account with the Bank enabling them to either invest the value overnight or offset other liabilities, thereby earning or offsetting interest costs on what would otherwise be non-earning assets.

The scheme encouraged and enabled commercial banks to establish their own cash centre facilities and saw significant investment in cash operations, including deployment of high-speed banknote processing equipment to sort banknotes fit for ATM dispensing and over the counter reissue. Unfit notes continued to be returned to the central bank for final authentication and destruction, in some cases through sample verification and subsequent bulk destruction.

With reduced central bank cash handling activity, the BOE closed four regional cash centres in 1997 and by 2001 all cash recirculation was outsourced to the commercial sector.

2001 also saw the updating of the original NHTO scheme into a more elaborate Note Circulation Scheme (NCS), for the first time differentiating working stock and long-term seasonal surplus stock. The scheme limited working stock in the 'sorting facility' to the equivalent of four days' worth of deposits to be processed and the long-term bond facility required a given denomination of currency to be paid in for no less than 14 days before being withdrawn.

Placing operating limits on the holdings provided an incentive to manage cash more efficiently. Following the regional branch closures and being previously uncapped, NHTO stock had risen from around 25% of total notes in circulation in 1990 to over 40% by 2000. The Bank also moved from full to partial sampling of unfit notes returned, thereby further reducing its own processing activity. The Bank typically only inspected 5-10% of all notes returned unfit and introduced penalties for errors found in these returns.

Minor changes to the scheme have been made over the years, for example modifying the sorting multipliers for different denomination notes to incentivise sorting and recirculation of the lowest denomination £5 note. Alongside significant work in recent years to review wholesale cash distribution arrangements (see **8.6.4**), the Bank is currently undertaking a full review of the NCS to ensure it remains fit for purpose.

8.6.3 Commercial sector cash handling

Historically, given the BOE's push to move recirculation to the commercial sector, and supported by their off-balance sheet arrangements, most of the major commercial banks maintained their own cash centre operations, with multiple cash centres found around the country.

With the notable exception of NatWest Group (which includes National Westminster in England and Wales, Scottish note issuer Royal Bank of Scotland, and Northern Irish note issuer Ulster Bank), all the other major commercial banks have outsourced their operations.

In 2007, Barclays Bank and HSBC merged their cash operations to form a standalone cash management company named Vaultex UK. The company is now the largest member of the NCS and supplies cash to over half of the country's 48,000 ATMs, requiring the packing of over 1 million ATM cassettes a year. Vaultex does not maintain its own cash logistics, contracting services from other industry suppliers.

Other major banks, Lloyds Bank and Santander, choose to outsource their operations to cash management company G4S, which provides both processing and secure CIT services. The government owned Post Office also maintains its own cash processing and distribution fleet and is a direct NCS member. With over 11,500 branches, the Post Office serves as a major provider of cash withdrawal and deposit services to both personal and business customers. Under its Banking Framework (recently renewed until 2025) it provides cash and other banking services to more than 30 British banks and building societies.

Smaller banks, building societies, and credit unions typically obtain cash services from the larger NCS members and the majority of financial institutions are members of LINK, the UK ATM network and switch. Today, approximately 90% of all cash withdrawn is from an ATM.

8.6.4 Forming a cash utility, wholesale banknote review

In May 2019, recognising the significant fall in transactional cash use (a Bank of England analysis concluded that cash processing volumes fell 46% from 24.5 billion banknotes in 2015 to 13.27 billion banknotes in 2020), the Bank established a Wholesale Distribution Steering Group (WDSG). Membership consisted of those organisations participating in the wholesale cash supply chain in the UK, including the NCS members, backing financial institutions, and the Scottish and Northern Ireland banknote issuers as observers. HM Treasury, and The Royal Mint as manufacturer and issuer of UK coin (on behalf of HM Treasury), also attend as observers, in addition to the current wholesale commercial operators. The WDSG agreed a series of success criteria against which potential future cash distribution models would be assessed, and invited industry to bring forward options.

In 2020, independent industry analysis commissioned by the WDSG concluded that a consolidated 'utility' model might best meet these success criteria, with further consideration required on the efficiency improvements that could be delivered by individual market participants. A public consultation was undertaken between June and August 2020 to invite feedback from the wider cash stakeholder community on this initial analysis.

The consultation defined a wholesale cash utility as a single consolidated entity formed and funded by a number of financial institutions who wish to provide wholesale cash services to their customers. The utility would be operated by a single new legal entity, with its own governance structures and arrangements. It would own the entire wholesale cash centre processing and storage infrastructure, but in order to promote competition, it was proposed that the operations of the cash centres and wholesale CIT arrangements would be outsourced through competitive tender periodically. The consultation also invited views on alternative scenarios, namely rationalisation within individual firms and industry-wide consolidation. The consultation set out the underlying assumptions of these scenarios and, based on these initial assumptions, a comparison to the utility.

Respondents encouraged WDSG members to undertake a robust assessment of a number of key areas to ensure any future model could maximise potential efficiency gains. They also challenged members to look closer at alternative industry-led solutions. Following the consultation, detailed work was undertaken to refine the utility model. This included further modelling of the business case and more accurate estimates of the potential efficiency improvements and up front and ongoing costs. The updated model and associated business case was then presented to members for individual consideration. WDSG members subsequently undertook their own individual assessments of the utility model.

Following the extensive review, however, members concluded that a utility solution was not possible. They considered that the potential gains were smaller than originally envisaged, and a number of risks were also identified with the utility delivery and transition plan, particularly around IT systems, operations, and competition processes.

The WDSG concluded that instead of a utility, industry-wide commitments were needed. In early 2021, firms agreed to a series of individual commitments with the Bank of England, covering Resilience, Efficiency, and Sustainability.

- **Resilience** – firms committed to ensuring adequate resilience of the wholesale cash infrastructure so that it can effectively underpin access to cash for wholesale and retail customers across the UK.
- **Efficiency** – firms agreed to work with the Bank to ensure processing efficiencies are maximised and costs are managed as usage of cash declines in the UK, so that cash remains an accessible payment method for as long as it is needed.
- **Sustainability** – firms agreed to reducing the environmental impact of wholesale cash processing, in particular by aiming for Net Zero for each organisation's own operations by 2030; and aiming to use 100% renewable electricity for each organisation's own wholesale cash operations by 2024.

Firms provide information and data to the Bank of England on a voluntary basis to help demonstrate that these commitments are being met.

8.6.5 Bank of England Codes of Practice for wholesale cash distribution

In June 2023, the Financial Services and Markets Bill was passed by UK Parliament. Under a new Part 5A of the Banking Act 2009, the Bank of England received new market and prudential oversight powers over the UK wholesale cash distribution market.

Following the passage of legislation, the Bank published its statement of policy on its supervisory approach to market oversight and enforcement for wholesale cash distribution, undertook

industry consultation, and in April 2024 published its formal and enforceable Codes of Practice.

The codes provide transparency on the minimum standards of conduct and practice that recognised firms must meet. The proposed codes are outcomes-based and are intended to enable an effective, resilient, and sustainable wholesale cash infrastructure. To support recognised firms in meeting the requirements set out in the codes, a data catalogue, reporting form, and guidance have also been published.

The codes comprise three individual codes addressing (1) data gathering and reporting, (2) third party arrangements, and (3) cash centre closure and market exit.

Operators and backing financial institutions are required not only to provide comprehensive business continuity plans, but detailed business operating plans to assess the viability, resilience, and risks associated with each business. Firms must set and report on sustainability targets, notify the Bank in the event of material events (of which there are 25 categories) and provide – in a standardised format – considerable information about their operations including Firm Financials, Sustainability Target Performance, Cash Centre Throughput, Service Level Agreement Performance, Vault Utilisation, and Wholesale Customer Flows.

8.6.6 Looking to the future

The central bank market oversight powers and published Codes of Practice provide the BOE with an in-depth appreciation of the health and sustainability of the UK's cash systems.

While these insights will enable it to see weaknesses and risks, and gives it powers to intervene, it remains to be seen how resilient the cash supply chain will remain with continued decline in cash use and growing cash access and acceptance challenges.

On a final note, as part of a response to ensure cash access, a number of shared banking hubs are being deployed, but these are being set up at a much lower rate than the considerable number of branch closures that have already happened.

9. INDUSTRY CASE STUDIES

9.1 NCR: DEMAND FOR ATMS EVOLVING AND GROWING

How ever you want to cut it, NCR Atleos (Atleos) is big in all things ATM. Data as of 23 June 2023, used in its September 2023 investor day, showed that it had over 800,000 installed ATMs. It has over 80,000 ATM locations that it itself owns and operates. It supports ATMs in over 140 countries and employs over 20,000 people around the world. It says it is number one in the world for retail surcharge-free networks, multi-vendor ATM software applications and middleware, and ATMs in 30 of the countries where its systems are installed.

Atleos earns 22% of revenue from hardware, 9% from software, 40% from services, and 29% from network transactions. It operates, therefore, across the whole spectrum of ATM provision and management. While 45% of its revenue is earned in the US, 30% comes from the Europe, Middle East and Africa region, 13% from Asia Pacific, and 12% from the Americas other than the US. Atleos has, therefore, a good global perspective.

9.1.1 Changing ATM landscape

Every country is different; some are reducing branch services; some are changing what they do. In both cases, the result is an increase in the density of self-service devices. More capable devices allow banks to solve the branch problem – either to free up branch staff to serve customers, or to allow banks to put this equipment into retail shops with their branding on it, enabling customers to access cash services away from a branch.

It is worth noting that the 'death of cash' is overrated in Atleos's experience. On its ATM network, cash transactions are up 12%. While the number of payment transactions may be rising, cash transactions are relatively stable.

9.1.2 ATMs in emerging market economies

In Emerging Market Economies (EME), such as Egypt and India, the number of people with bank accounts is growing fast. Even so, at the moment cash is still the primary transaction method and so the need for ATMs is high. The ATM services required are not yet complex.

However, the infrastructure required to sustain a modern ATM network can be missing and this can be a constraint on economic growth. Atleos, with the experience of running its own network, has a programme to share its operational experience with them.

9.1.3 Interchange fees and surcharges

Atleos works closely with state-owned banks and central banks on interchange and surcharge policies, since these are key to creating a profit motive for providers, balanced with a cost structure that enables and promotes the economy.

Often the authorities are not focused on maintaining a robust ATM system but on costs. The result is an uneconomic network, leading to ATM closures. One response is a utility model such as those being pursued in the Netherlands and Belgium. Another is the Allpoint system provided by Atleos to institutions, providing them with the ability to offer their customers ATM services in areas where they have closed branches or there are few financial institutions. Usually these are positioned in retail locations. Allpoint is surcharge-free for users. Atleos describes this as a market-driven model.

The density of ATMs relative to the population makes a difference when it comes to fees. A national interchange fee may not be appropriate.

9.1.4 Recycling and recirculation

While the recirculation of banknotes once issued by the central bank is an activity that has always happened and been managed, the recycling of banknotes close to the point of use is new.

With the rising adoption of banknote recyclers in bank branches, and now with 'Interactive Teller Machines' (ITMs), recycling is fast increasing. Atleos advises on note quality, filling cassettes, and other cash management activities to spread efficiency best practice.

9.1.5 Role of data

ATMs count notes issued. Recyclers count, authenticate, and fitness check notes. ATM management companies use the count to determine refilling schedules and to manage stocks, but only at an aggregate level.

The flow of data in the cash cycle goes two ways. Central banks hold macro level data on cash patterns that is useful for cash management organisations when planning operations. Equally, micro level regional data, aggregated rather than granular by machine, is useful for central banks to understand currency flows and cash demand.

As more ATMs and ITMs are used, the opportunity for more granular data exists.

9.1.6 End-to-end ATM solutions

Atleos is seeing an evolving technology and service environment, with customers looking for a more end-to-end solution. An important caveat here is that the scale of ATMs a client has makes a difference. Unless the client is running a significantly large ATM operation, they can struggle to have the resources, skills, and knowledge to optimise it and keep up with the changing demands made on their machines.

Atleos promotes the adoption of an integrated end-to-end model called ATM as a Service (ATMaaS) because it allows quality to be better controlled and assured, and for bank resources to focus on strategic business priorities. It also argues that it offers a lower and more predictable total cost base.

Atleos sees its role as a designer, manufacturer, software and service provider, and independent operator of ATMs as key to its ability to compete and offer ATMaaS to banks that can benefit from this approach.

9.1.7 Sustainability

Sustainability, closely aligned with efficiency and operational costs, has been on Atleos's agenda for a long time. However, it has seen a rapid and significant change in recent months with Requests for Proposals suddenly including questions about sustainability. This customer 'demand' is just starting.

Ultimately Atleos can engineer into its ATMs almost whatever the customer wants, with the understanding that this can impact cost. Up until now, in line with the ATM Industry Association's sustainability work, Atleos has focused on the lifecycle of ATMs, for example increasing the proportion of recycled materials used in new machines, lowering the power requirement of machines (saving $200 per month by reducing the wattage, for example), and including a 'sleep mode' on devices.

9.1.8 Final word

Atleos sees increasing demand for more capable ATMs and ITMs driven by changing banking trends, growing demand for ATMs 'as a service' and utility ATM network usage models, driven by wanting lower costs and branch optimisation in Advanced Economies, and to meet rapidly grown demand in Emerging Market Economics, driven by continued economic reliance on cash and increasing digitisation of social services, and a new focus on and interest in sustainability.

Underpinning this is a continuing strong demand for cash by consumers and demand for cash services by banks, retailers, and consumers.

9.2 DIEBOLD NIXDORF: SUSTAINABLE CASH OPERATIONS FOR THE FUTURE OF BANKING

According to Diebold Nixdorf, the payments landscape continues to shift as digital innovation introduces and shapes new customer offerings. In line with this, all recognise that how cash is used is evolving – but it is clear that cash is here to stay and remains an important part of the payments mix for end consumers.

The maturity of access to cash varies across different countries, and the protection of physical tender is increasingly under the spotlight from regulators and government bodies in an effort to maintain the 'consistency of cash'. Not only is it the social responsibility of financial institutions to provide access to cash in a financially inclusive manner, but also the industry as a whole to protect choice for future generations.

With this in mind, Diebold Nixdorf asks how access to a banknote can be made more economical to ensure the longevity of cash in a sustainable way? There is a clear industry focus on driving efficiency measures across almost every part of the banking ecosystem, and payments is no exception. The good news is that efficiency and sustainability go hand in hand and there are clear strategies that can be implemented to optimise the cash cycle process.

The three focus areas that can make the biggest impact in this space and drive the greatest returns are considered below.

9.2.1 The ATM as an efficient branch

As branch networks reduce in numbers across many parts of the globe, new branch formats have emerged. From ATMs as the branch, to pop-up branches, these are not only plugging gaps in services but also crucially maintaining access to cash and banking solutions for society. However, such leave-behind strategies need to be efficient, effective, and sustainable solutions for the long term. This is where technology can be leveraged to maximum effect.

Diebold Nixdorf recognises that the self-service channel is becoming increasingly important as a physical touchpoint for consumers as part of this shift away from traditional branches. It also recognises the need for greener banking; therefore, its ATMs are designed to satisfy both consumer demands and financial institutions' need for sustainable solutions.

DN Series® ATMs are built to reduce the systems' environmental impact, both during its manufacturing phase and throughout its useful life. In the past 10 years, electricity consumption in individual systems has been reduced by two-thirds, while the performance of these

same systems has multiplied. This has been achieved by using advanced and energy-efficient technologies, such as energy-efficient processors.

The DN Series 200 model is made of recycled and recyclable materials and is 25% lighter than most traditional ATMs. This reduces CO2 emissions, both in the manufacturing processing and in transportation of components and terminals. The DN Series 200 ATM uses state-of-the-art LED technology in all its lighting systems and efficient electrical systems, which enables savings of 25% in electricity consumption compared to traditional ATMs, a figure that rises to 50% if it is equipped with an energy-saving mode.

Taking Germany as an example, implementing DN Series ATMs has reduced energy consumption by 45%, reduced C02 released by 50%, and saved 45% in euro energy costs[6].

9.2.2 Technology with sustainability as its first focus

In addition to an environmentally conscious approach to manufacturing ATM solutions, leveraging innovative software and maintenance solutions can also support an optimised cash cycle process.

Artificial intelligence is becoming further ingrained into everyday lives and is also helping to support efficient maintenance of ATM networks. Starting over 10 years ago, Diebold Nixdorf began gathering Internet of Things (IoT) sensor data from live ATMs and analysing it to track and continuously improve the performance of existing devices.

Featuring 150 sensors and 100 data points, Diebold Nixdorf's AllConnect™ Data Engine™ (ACDE) solution processes data to provide actionable insights in real-time. For example, performing remote diagnosis on an ATM to avoid sending an engineer out to the site unnecessarily. This proactive approach to maintenance allows the company to partner with financial institutions to provide environmentally friendly and cost-effective operations.

Software can also be a key enabler for positively shifting the sustainability dial. For example, in the Swiss market, Diebold Nixdorf has successfully delivered a Green ATM concept which implements power management software. To reduce energy consumption, the software schedules idle periods, and ATMs can be remotely set to sleep mode when not in use.

9.2.3 Embracing the power of cash recycling

A significant area for optimising the cash cycle process is cash recycling. Although cash recycling is not a new concept, its implementation varies across the globe. With a renewed focus on cost reduction and achieving productivity improvements, it is likely greater attention will be paid on cash recycling in the future.

Recycling adoption can satisfy financial requirements and the total cost of ownership (TCO), by reducing the latter by up to 20%. In addition, cash replenishment costs can be reduced by up to 75%. This not only adds up to significant savings for the financial institution but also reduces the number of visits a CIT provider must make, thus reducing the associated environmental impact.

Diebold Nixdorf benchmark data shows a 63% increase in cash deposit transactions since 2010[7], which demonstrates how ATM transaction trends support a recycling approach. Recycling the cash within the system not only leads to optimised operations but also ensures high availability for the end consumer – a vital requirement for today's 'instant service' driven society.

In summary, says Diebold Nixdorf, an optimised cash cycle means embracing technology equipped for the future. This includes efficient and effective hardware, supported by intelligent software, artificial intelligence, and data-led insights, and backed by a streamlining of processes, such as implementing cash recycling solutions. Cash remains an important part of society, and cash management will remain a major and mandatory part of financial institutions' day-to-day operations.

Therefore, actioning meaningful change now can build the foundation for a sustainable and cost-effective future.

9.3 BRINKS GLOBAL ATM SOLUTIONS

Sustainability is increasingly in the values of banks and is progressively appearing in Requests for Information (RFI) or Requests for Proposal (RFP). The situation is changing fast as a result. RFIs are including targets such as no diesel, using Hydrotreated Vegetable Oil (HVO)[8], and setting CO2 reduction targets. Some customers are prepared to accept the higher costs implied. For example, Geldmaat knows that stipulating that HVO fuels is used will increase costs.

Less mileage requires better cash management. While dynamic forecasting is standard, linear

6 The basis for the energy costs is the average energy cost in Germany is 2023 and may vary depending on the region and provider.

7 Diebold Nixdorf client benchmarks 2010 to 2023.

8 'Hydrotreated vegetable oil (HVO) is a biofuel made by the hydrocracking or hydrogenation of vegetable oil.'

route planning techniques, such as geo grouping, allows efficient day and area planning.

9.3.1 Local recycling

Is there a balance between withdrawals and deposits that allows more recycling? Although this is more expensive, the cost of cash ownership is high, and so local recycling is increasing. The use of very local cash centres offers real benefits.

In Belgium, two-thirds of Batopin's new cash handling machines are recycling devices to reduce costs.

9.3.2 Case study of local recycling

Brinks provides a Digital Retail Solution to the largest retailer in the Netherlands, Albert Heijn. It has installed Smartsafes at all the cash tills. Geldmaat, the Dutch ATM pooling company, has 1,000 ATMs at these stores. Brinks has been able to combine the servicing of both the ATMs and the Smartsafes in one stop. Where sufficient cash is available, it can use cash from the Smartsafes to fill the ATMs. The result is fewer cash pickups and fewer trips.

The combination of Smartsafes and a co-located ATM estate served by the same organisation has allowed better cash management, fewer stops and, therefore, lower costs and the creation of less CO2.

9.3.3 Access to cash

Access to cash is now on the agenda, and so regulations from central banks aim to sustain continuity at prices that are not unreasonable. Commercial banks are being asked to guarantee access to cash. They are even being asked to install more ATMs. Therefore, the market is changing.

9.3.4 Optimising maintenance

Machine maintenance and repairs are also important. The trend is to combine first and second line maintenance. Previously, machine suppliers such as Diebold or NCR provided second line maintenance, but increasingly this is combined, with Brinks carrying out the cash delivery and maintenance.

In the Baltics, Ireland, UK, and the Netherlands, single line maintenance is done all in one trip, increasing up time and reducing mileage. Only one person needs to be there, although some countries still require two people to be in attendance.

While IBNS systems are more complex, needing disarming before maintenance can happen, they do mean that vehicles can be 'soft skinned' and only one member of staff is needed.

9.3.5 Advantages of deposit matching

Returning cash to central banks should not be a requirement. Matching of deposits is now good, allowing stock from multiple banks to be combined and managed in one step. Stock separation is not needed.

9.3.6 One advantage of fewer branches

There is a trend for ATMs to move from bank branches and into lobbies. This has the advantage of requiring less CO2 in the materials required to create the branch 'bunkers'.

9.4 BANTAS: SUSTAINABILITY & CASH SERVICES – A CASE IN POINT

BANTAS is a joint subsidiary of three commercial banks, and the leading cash services provider in Turkey. It has around 1,800 employees, and 46 cash centres with 490 armoured vehicles across the country. It is the sole provider in Northern Cyprus.

9.4.1 What is driving change?

In Turkey, sustainability practices are developing as *de facto* industry standards. Any regulations concerning the industry and sustainability come from the banks and corporate customers, which they impose on their providers, CIT suppliers.

Larger banks, mostly subsidiaries of multinational banks, have started both questioning their indirect CO2 footprint through their providers, and asking for the use of more environmentally friendly materials to be used in the delivery of their services. Some banks go further and ask their CITs to use recyclable material in the provision of their services.

In addition, general 'commercial regulations' guide the industry on issues such as recycling or environmental awareness. Recent taxation of plastic bags used in shopping is one example.

BANTAS is a substantial player in cash circulation in the country. Therefore, the impact of any sustainability changes on the cash supply chain and cash circulation has a direct bearing on the company. Consequently, it is very sensitive about sustainability and has chosen to take a formal corporate stance on the matter.

However, BANTAS looks at sustainability in its broadest sense, with all its aspects in line with the UN's 17 goals for sustainable development. The motivation stems from the fact that sustainability is closely linked with being able to grow over the long term in harmony with its stakeholders.

9.4.2 Organising for change

BANTAS issued a draft 'Policies and Principles on Corporate Sustainability' document in January 2022, outlining its attitude, goals, and objectives in the following areas:

- Core values
- Corporate governance
- Gender equality and inclusion
- Accident, damage, and risk management
- Creativity and continuous improvement
- Environmental awareness
- Digital transformation and automation
- Social responsibility
- Ethical behaviour and compliance.

Each line item has a set of ongoing practices and activities, along with achievable targets across multiple timeframes.

9.4.3 Environmental projects undertaken

Looking at environmental impacts in particular, some of BANTAS' current projects already developed or underway include:

- Using vehicle routing software to calculate optimal routes for its armoured vehicles, so that the routes will be completed within shortest distances and time. This translates into both savings and less CO2 emissions.
- Keeping a record of fuel consumption on each of its 490 vehicles on a monthly basis, and taking actions on outliers, both for economic and environmental purposes.
- Using a driver performance monitoring system, recording and scoring its drivers on safe and economic driving habits on a daily basis.
- All lighting in cash centres being replaced by LED technology, leading to less energy consumption.
- Canvas bags being the primary choice for cash and valuable shipments, unless otherwise required by the customer.
- Only recyclable plastic being chosen when needed, like security seals.
- Old tyres being recycled in commercial reprocessing plants.
- BANTAS soon having its first fully electric drive armoured vehicle. More will be planned for future based on the experiences from the first one.
- Digital transformation, which allows for a more paperless environment being encouraged in all areas. Consequently, paper consumption is limited only to the level required by the regulatory framework.

9.4.4 Project payback

It is hard to quantify the benefit of such work. For example, while LED lighting clearly saves considerable electricity, cash processing machines also consume energy, and it is difficult to differentiate the exact share of lighting. Similarly, canvas bags are costly to produce, and their cost is amortised over their lifetime. The higher cost of buying electric vehicles is known but BANTAS does not have sufficient data yet to know their actual total cost of ownership.

Most of the projects are 'spend-to-save' projects. As a result, specially allocated budgets were required to proceed with them. Vehicle routing software is a good example. BANTAS has worked over several years to identify the right product. It has been expensive to buy and adopt and the company expects payback to take a certain period of time.

Some projects have been pursued because they are the right thing, even though they have increased the cost of doing business. Electric vehicles fall in this category. In addition to the cost to purchase, they come with additional costs associated with the relative scarcity of recharging stations, service facilities etc.

9.4.5 Setting targets

As for measurable and quantifiable goals, BANTAS still has some distance to go. Savings in areas such as LED lighting or reusable canvas bags are clear cut, but setting CO2 emission limits must be balanced against the company's contractual obligations and commitments to its customers. Therefore, more work is needed in environmentally conscious spend-to-save projects towards sustainability.

BANTAS believes that CO2 reduction will be its priority, but it has not yet formally set any targets. It has decided to measure its CO2 footprint for 2-3 years and only then set short, medium, and long-term targets, considering data for each of its particular business lines. For the time being it is treating its environmental work on a bona fide best-effort basis.

9.4.6 Advantages of a NHTO scheme

The NHTO or 'Custodial Inventory' scheme initiated by the Central Bank of the Republic of Türkiye (CBRT) in 2018 allows certain banks and CITs to hold in custody, process, and distribute cash on behalf of the CBRT. BANTAS runs two such depots in Istanbul.

The primary advantage of the NHTO scheme is that it speeds up the bulk/commercial cash cycle

by eliminating frequent runs between cash centres and CBRT depots. This not only cuts down on CO2 emissions due to those trips, but also avoids repetitive processing of banknotes on both sides, thereby allowing for longer duration in circulation.

Durable banknotes translate into lower unfit rate in processing, hence lower replacement costs and less detriment to nature. Consequently, fewer trips between cash centres and CBRT depots for destruction and renewals.

9.4.7 Final word

This is a good example of a CIT taking measured steps for the right reasons to reduce the environmental impact of what it does. There is an interesting mix of projects implemented because they are the right thing to do and those which reduce costs and increase operational efficiency, alongside providing environmental benefits. The role of commercial banks and corporate customers is both direct and indirect, leading to collective efforts for more comprehensive sustainability targets in cash logistics.

9.5 ACMA: OVERVIEW OF CASH HANDLING ACROSS ASIA

An interview with the Asian Cash Management Association (ACMA) offers a snapshot of what is happening across Asia. Common themes include reducing the number of central bank branches, little use of NHTO schemes, cross-trading of surplus cash, low levels of capital expenditure, retailers not recycling, and high levels of insourcing of CIT services.

ACMA believes banks are starting to think about managed services for ATMs, probably starting with monitoring services. Euronet has started to make progress in Indonesia and the Philippines, running bank branded ATMs. The numbers are still small and there are challenges around CIT support and supporting remote ATMs.

Getting commercial banks to regard brown label ATMs as a shared resource is proving hard since they see having their own ATMs as a competitive advantage. A 'brown label' ATM is an ATM where the hardware and lease are owned by a service provider, while the bank manages cash and network connectivity. These ATMs display the branding of the bank but are not directly owned by them.

Machine maintenance is important in the region because of the age of the ATM fleets. As a result, first level maintenance calls numbers are high.

Recyclers are not widely used in the region. In addition to their higher initial purchase cost, they are more delicate than standard ATM, requiring more maintenance. They also require frequent replenishment.

9.5.1 Philippines

With 7,000 islands and 70% of the population with no bank account, cash is still core to people's lives, but cash management is complex.

80% of CIT movements remain insourced by commercial banks, with independent cash management companies still not part of the 'trust cycle'. Commercial banks can dictate to their retail customers how cash will be managed.

The commercial bank market is highly competitive, with 36 commercial banks and hundreds of regional banks. Reducing costs is important to them. This is leading to new thinking by banks such as BPI, BDO, and Metrobank, including outsourcing cash collection and introducing deposit safes that gives the retailer next day credit on their deposits. This allows the CIT to collect cash weekly.

Bangko Sentral ng Pilipinas (BSP), is building a new cash centre but, at the same time, it is closing central bank branches in some regions. 60% of the people living in the northern island around Luzon are without accounts, but the central bank footprint here is poor.

BSP appears to be focused on digital payments rather than engaging with cash management businesses. Permission is still required to outsource from commercial banks and there are tight rules about picking up central bank money by commercial banks. On the other hand, BSP does allow commercial banks to sell cash to each other to balance cash needs.

9.5.2 Thailand

The number of central bank branches has been reduced from 70 to nine over the last few years. The major cash operators are Brinks and Guardforce, along with three local companies. The Bank of Thailand audits the cash centres and does allow cash to be sold between banks.

9.5.3 Malaysia

Bank Negara Malaysia (BNM) only takes unfit notes from commercial banks and cash operators. There are 10-11 cash operators with Safeguard, Brinks, Armaguard, and Securiforce being the biggest. CIT vehicles must have two armed guards, and they must be approved individuals. Cash centres must have armed guards. The usual rules apply – that ownership must by 70% by 'sons of the soil' and 30% of staff must be Malaysian – (Similar rules apply in the Philippines).

Security companies must be licenced by both the police and the ministry. Meeting the requirements and getting approvals is a complex and slow business.

9.5.4 Singapore

Singapore police licence CIT companies. They conduct annual audits of companies, and they prescribe staff training and pay. If movements of over S$250,000 are being made, an armed guard must be on hand from Temasek, the investment arm of the government. Brinks is the only external CIT and that is primarily because it holds US dollars with the Federal Reserve.

9.5.5 Vietnam

CIT services are insourced.

9.5.6 Hong Kong

60% of CIT services are insourced.

9.5.7 Indonesia

As with the Philippines, Indonesia consists of many islands (15,000) and a large unbanked population (60%). E-wallets are prevalent and widely used. It does, though, have 24 CIT companies.

Bank Indonesia is becoming more involved in the cash cycle but wants to accept unfit notes only. It does have an unfit note policy, audit cash centres and licence CITs. It does not have a NHTO scheme.

10. CONCLUSION

It feels like the pace of change relating to cash is increasing. The drivers vary around the world, of course, but the results are similar, a need for efficiency at every stage of the cash cycle. While cost savings are always welcome, so too are the reductions in the environmental impact of cash that come with those changes.

While the underlying causes of change vary, technological developments are both part of the change and an opportunity to do better. These include developments in automation, leveraging the power of data to streamline operations, new, greener power sources, and equipment that uses less resources etc.

Alongside that comes the opportunity to change processes. Sometimes this is driven by consumer behaviour, by technology, or as a conscious decision to do things differently. Different processes come in many forms – local recycling, adopting standards such as GS1 or CashSSP, inter-bank co-operation, new business models such as outsourcing ATM management and/or utility ATM models, and central banks introducing or widening balance sheet relief schemes for banknotes etc.

This paper provides many examples of change. Since no one country is the same, there is no point in recommending a solution. Instead, we offer here options that can stimulate your thought and, perhaps, provide a starting point for re-thinking what you do. This is irrespective of where you sit in the cash cycle or in the world. Hopefully we can reduce the environmental impact of cash, make cash more resilient and save money!

ANNEXES

ANNEX A: BANKNOTE DESIGN OPTIMISATION

Velocity in circulation

How frequently a banknote is used is known as its velocity in circulation. If a banknote is circulating fast, as opposed to being stored in a wallet, till or safe, then it is working hard, and fewer banknotes overall are needed, reducing the environmental cost of making them. Some substrates stay fit for longer than others. If cash is going to circulate fast, it needs to last.

Design choices for long lasting banknotes

Polymer substrate lasts longer than cotton substrate. While there is a debate about whether less polymer is an absolute good, banknotes do get returned to the central bank and it is straightforward to recycle them. Meanwhile, cotton substrate banknotes can now have extended lives with the use of coatings and/or varnish coatings. Hybrid substrates also exist. Good progress is being made with enabling these substrates at the end of their lives to either be recycled or to be put to good use in other products and applications.

The ECB now requires all its cotton banknotes to be made from sustainable cotton. The ECB started the implementation of a sustainable cotton programme in 2014 which became 100% mandatory in 2023. This required the use of sustainable cotton fibres in paper making because it has a significantly lower environmental impact than alternatives.

Each denomination has its own role – market notes are used similarly to a coin as change in the market or for low value purposes, payment notes are used for more substantial everyday payments or store of value notes. The design needs to be appropriate for their purpose, for example whether a store of value note that rarely circulates should be made of polymer also needs to be considered.

In addition, some design choices allow a banknote to last longer – intaglio printed on both sides of the paper, less white paper, and pastel colours etc.

The security features need to continue to be usable for the lifetime of the note.

Efficient denominational structure

The denominational structure of coins and banknotes should be designed so that the fewest are used to conclude a payment. Over time, of course, inflation and other decisions mean that an originally logical structure becomes inefficient. This results in more banknotes and coins being used than should be. Changing currency structures is a big decision but central banks need to decide how much inefficiency is acceptable.

Optimum number of notes per head of population

If too few banknotes are circulating, velocity increases, perhaps to the point where note life is foreshortened. There is a balance to be achieved.

The US$1 banknote has an extremely long note life. This is often explained by the linen used to make the substrate and the producer, Crane, claims to have a special process that also contributes to the paper's durability. Perhaps another contributory factor is just how many dollar bills are circulating per person. At the time of the change over to a polymer £5 banknote in the UK, the £5 had a note life of about nine months. But there were only five notes per head of circulation at the time, compared with 18 dollar bills per person in the US.

Effective mechanism to withdraw notes from circulation

A circulation 'eddy' is when notes get stuck in a localised loop of use and reuse such that they don't return to a cash centre. As a result, the quality reduces. Retailers need to be able, and willing, to return notes to cash management companies easily and at a price that they deem reasonable. The cash cycle needs to allow a two-way flow of notes and coins.

ANNEX B: ATMS AND NET ZERO

At the 2022 Cash Sustainability Forum, npower, a UK power company which is part of the German Eon group, summarised the challenges in achieving net zero as including:

- Understanding your Green House Gas (GHG) emissions across the three scopes
- Knowing how to model your business to set realistic targets
- Being clear on the business case for getting to net zero

Npower also provided a neat summary of possible technologies to assist with a reduction to zero emissions.

Using less power

Producers of ATMs have recognised the need to use less electricity. Diebold Nixdorf reports that over the past 10 years electricity consumption in individual systems has been reduced by two-thirds, while, at the same time, what those machines do and how they do it has changed significantly.

This improvement has been achieved by using advanced and energy-efficient technologies, such as energy-efficient processors, utilising LED technology in all its lighting systems, using efficient electrical systems and offering an energy-saving mode. While the first of these changes enables savings of 25% in electricity consumption compared to traditional ATMs, the energy-saving mode alone allows a further 25% saving.

When Geldmaat migrated the existing network of 9,000 ATMs to a network of 5,000 machines for notes, coins, withdrawals and deposits, it was able to invest in the latest equipment with significant environmental benefits, a hidden benefit of transitioning to a utility model.

Buying Renewable Energy

There are two ways of calculating grid electricity. The locational grid average, which works out the total emissions from all generation as a proportion of the total electricity generated, 0.19kg CO2/kWh in the UK, and the market-based method where organisations have a contractual arrangement based on Renewable Energy Certificates (REC), Guarantees of Origin or other contracts. For this method users can claim the attributes associated with renewable energy, ie. zero kg CO2/kWh.

About 2,000 companies use the market-based method to report CO2 emissions to the Carbon Disclosure Project (CDP), for example Google, Unilever, and the Royal Bank of Scotland.

There are two, related, problems with the market-based method. First is additionality. If the renewable energy project existed without the company buying the REC, then the purchase has not added to the stock of renewables. Npower's presentation then provided a long list of independent empirical studies that show no or limited additionality.

Second, GHG disclosures are not necessarily accurate. Even if a company reports zero emissions from electricity consumption, they are still drawing electricity from the grid, creating emissions. Unless there is proven additionality, they have not added to the stock of renewable energy. In addition, there is a risk of 'distraction,' ie. the company does not feel any imperative to reduce consumptions and so takes no action.

The solution is either to use only the locational method while reporting the impact from contractual arrangements separately or to prove additionality alongside the market-based method. This is where the Power Purchase Agreement[9] (PPAs) referred to by npower can be useful, where they have led to the creation of additional renewable capacity. The GHG Protocol is aware of the problem and is looking to revise their standards.

Doing carbon offsetting 'well'

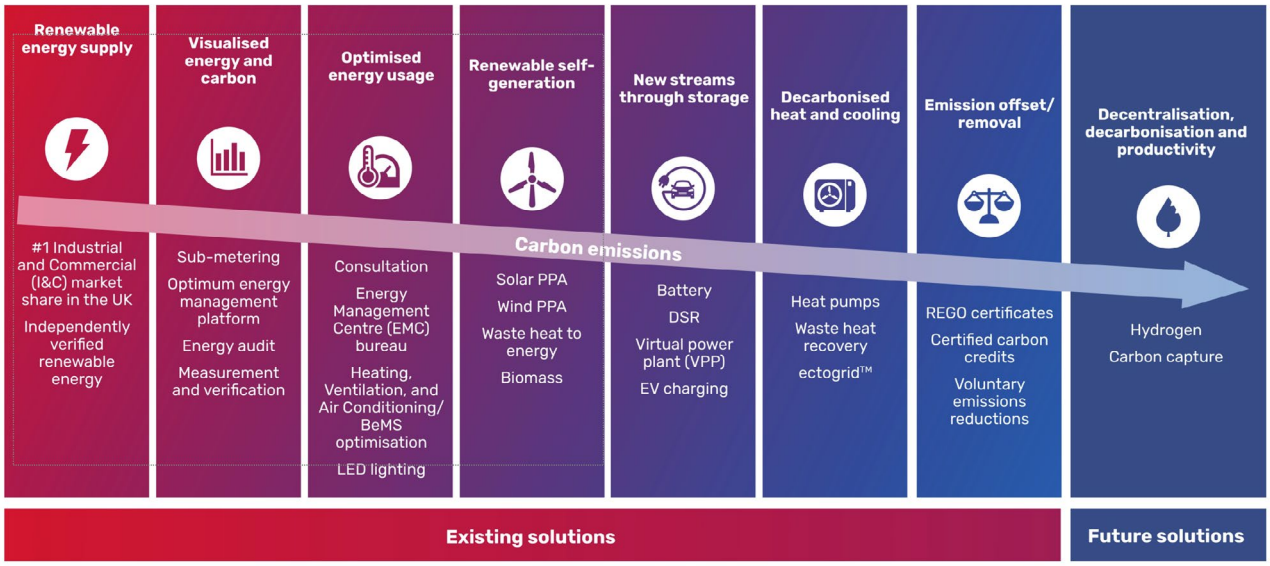
Carbon offsetting involves buying certificates that are linked to projects designed to absorb carbon from the atmosphere. The first challenge is identifying projects and then validating and verifying that those projects are real, measurable, additional, independently verified, and unique.

There are a wide range of credit standards and not all are reliable. Again, at the 2022 Cash Sustainability Forum, THG Eco recommended three: Gold Standard (Verified Emissions Reduction), Verified Carbon Standard (VCS), and the Certified Emission Reductions (UN Framework Convention Climate Change CDM).

The standards set global benchmarks for rigorous third-party monitoring, reporting, and verification procedures, provide the infrastructure needed to issue, trace, transfer, and retire carbon credits and show evidence of ownership to prevent double counting.

Each project needs to be sourced from a credit standard with a unique project number, the

9 A PPA is a long-term contract where a company agrees to buy electricity from a power producer at a fixed price. It is often used to purchase renewable energy, like solar or wind power.



country of origin, the methodology that defines the product type, the year the offsets were generated, features (for example the United Nation Sustainable Development Goals (UNSDGs) it covers), the quantity in tonnes offset, and the unit price of the credits.

Types of credit

There are two types of credit. Avoidance credits cover projects that allow people to avoid emitting carbon, eg. renewable energy projects. 90% of projects are avoidance projects. Removal credits are for projects that directly capture carbon from the atmosphere and store it within the system, for example blue carbon (mangroves), brown carbon (soil carbon, biochar), and direct air capture.

There are pros and cons for whether carbon credits are bought through a broker, over the counter (OTC), or in an exchange. While OTC is the lowest cost, it is also the longest and most complicated. Using a broker is the most expensive but provides the best project selection. An exchange is quick but allows no direct project engagement and limited project choice.

ANNEX C: UK'S CASH INDUSTRY ENVIRONMENTAL CHARTER (CIEC) GROUP: COLLECTIVE CHANGE

The CIEC has three areas of focus – energy, carbon, and plastic – and is pursuing four targets:

- Achieve Net Zero for 'Own Operations & Business Travel' by 2030
- Eliminate single-use non-recyclable plastic in note centres by 2030 (25% in 3 years, 50% in 5 years, and 100% in ten years)
- Reduce single-use non-recyclable plastic in coin centres to below 45% of plastic waste (by weight) by 2030, (2023 < 70%, 2025 < 50%, 2030 < 45%)
- 100% renewable electricity – own operations by 2022

This co-operation makes sense because the Bank of England sets what is known as 'Standard 21' which all parties in the cash industry work to. Working together to organise cash within that regulation, and to lobby for change where appropriate, as an industry is an opportunity to be more efficient and with less environmental impact.

Making a good idea work

UK Finance is the collective voice for the banking and finance industry. It represents around 300 firms across the industry, acting to enhance competitiveness, support customers, and facilitate innovation. Within UK Finance, Cash Services acts as the secretariat for the CIEC.

Terms of reference were established.

- The group meets on a bi-monthly basis, originally monthly, and usually online.
- The group exists for collaborative, non-commercial discussions in line with the Cash Industry Environmental Charter to:

- Share operational best practice (transport, packaging etc.), allowing members to reduce the environmental impact of cash
- Update the UK Finance Cash Policy Committee and seniors within member organisations on environmental matters relating to the cash supply chain in the UK.

The objective is to provide an impartial, non-competitive forum where strategic discussions can be held to identify operational changes that will enable the industry to work towards the Charter targets and generally improve efficiencies in the cash cycle.

Membership is open to any organisation with an interest in the cash supply chain in the UK, together with The Royal Mint and Bank of England.

As regards decision making, wherever possible, consensus is to be reached on all substantive matters considered. If consensus cannot be achieved, members are entitled to develop their own solution either individually or bilaterally.

Data is shared for each charter objective. UK Finance collects and maintains data, presenting updates to each meeting. While the data itself is confidential, UK Finance has shared an example of the layout of the plastic inventory:

- Item of plastic
- Material used
- Use
- Recycled, recyclable, biodegradable, reusable? How do you deal with this waste?
- Possible alternatives? What do you use instead? What controls are in place?
- Any blockers to change? Is there anything the group can do to help?
- Any other activity/pilot scheme or trials underway?

ANNEX D: HOW CENTRAL BANKS DECENTRALISE CASH MANAGEMENT TO THE PRIVATE SECTOR

Unless a country is geographically compact and/or small, central banks have looked for alternative ways to manage cash without constantly increasing the additional capacity, equipment and resources required.

Delegation, or decentralisation, is one such way.

Restrict access to central bank services

The bluntest lever to reducing reliance on central bank services is simply to restrict access. This can be achieved in several ways and while potentially achieving the central bank's goal of reducing cash handling resources (or avoiding their expansion), alone they do not necessarily ensure good outcomes across the commercial sector.

Closure or rationalisation of central bank branches

Heavily influenced by geography and demographics, a central bank may have a large branch network to meet cash supply and banking needs. For example, at one time the Banque de France had more than 200 branches across France, it now has 23 centres (and a further 16 commercial sector operated auxiliary banknote storage facilities).

Central bank branch closures, without supporting arrangements, or policies for commercial sector recirculation, while limiting central bank resourcing requirements, are likely to simply move the problem and potentially create market inefficiencies. At best it will necessitate greater commercial sector recirculation (either by individual organisations or collectively), but at worst may simply increase activity at other central bank branches, create greater environmental impact from extended transportation over long distances, or lead to a breakdown in efficient cash cycle movements.

As a positive, central bank consolidation may afford the opportunity to move cash processing from existing locations – sometimes historic buildings not designed for streamline processing operations, perhaps in the heart of a congested city centre, to purpose-built facilities that can be designed to meet modern environmental and sustainability considerations.

Restriction on central bank hours or days of operation

Another way to limit demand for central bank cash resources is to limit hours of operation, to restrict deposits or withdrawals to certain days, or potentially to restrict access seasonally.

For example, acknowledging seasonal demand around holidays or festivals such as Christmas or Eid, central banks may allow withdrawals in the days or weeks leading up to the event and allow deposit of surplus currency for a period thereafter, but at other times of the year restrict deposits only to certain categories, such as unfit notes.

Again, this may achieve the desired goal of reducing central bank cash processing, but could simply shift the underlying problem, or condense processing activities into narrow time windows and then create processing backlogs.

Restrictions on cash velocity, cash withdrawal and deposit frequency (cross shipping)

In a system where the central bank cash centre plays a central role, high circulation velocity may result in high levels of cash handling, increasing pressure on central bank cash services. It may be appropriate to limit the frequency between when one institution withdraws and redeposits fit currency of a given denomination.

The US Federal Reserve has a clearly defined cross-shipping policy which it first implemented in 2006 to limit the number of $10 and $20 banknotes (widely used in ATMs) that were withdrawn and then redeposited within a short space of time. The Federal Reserve introduced limits on how many bundles, above a de minimis exemption level, could be withdrawn and subsequently redeposited within a Federal Reserve Zone (or prescribed sub zone) within a single business week. As of 2024, the Federal Reserve charges a fee of $6.50 per bundle for banknotes deemed to be cross shipped.

The cross-shipping policy was introduced alongside a domestic custodial inventory program to support the off-balance sheet holding of banknotes that are actively recirculated rather than being returned to the central bank.

Restrictions can be applied across all denominations, or relaxed or tightened for a given denomination, for example to encourage greater recirculation and processing of lower value notes or dissuade recirculation or issue of higher denominations.

Currency packaging standards, minimum/maximum deposit or withdrawal limits

Where central bank resources are overused and there are no, or low, limits to the withdrawal or deposit quantities, it may be that commercial banks are withdrawing and depositing to fulfil individual branch or business customer needs.

The introduction of order/deposit minimums and packaging standards can be used to differentiate between wholesale supply and retail cash handling. For example, a central bank might prescribe that cash can only be withdrawn in full cages or containers rather than single bundles, or that a deposit must be for a minimum number of bundles. This of course then forces intermediate steps in the commercial sector to break down orders, or aggregate deposits, into the required central bank multiples.

The outcome, while meeting the central bank's objectives, may either be positive or negative for the commercial sector. At worst this may introduce unnecessary additional handling, at best it might encourage within an organisation, or across organisations, greater localised recirculation and trading.

Introducing packaging standards does enable consistency across the cash supply chain and can support more effective inter-bank trading of currency.

For example, a central bank (or at a commercial off-balance sheet banknote store) might accept sealed and identifiable banknote bundles on a bulk basis, not open these for processing, but reissue these bundles to the same or another organisation when required. Specific rules to support subsequent verification and handling of claims if there is an error or counterfeit detected can be implemented, with the receiving organisation making a claim directly with the original depositor.

Developing national currency packaging standards also affords the opportunity to review environmental considerations. For example, in the UK, the Cash Industry Environmental Charter Group has set targets for the reduction or elimination of single use non-recyclable plastic for banknote and coin packaging.

ANNEX E: OVERVIEW AND COMPARISON OF CENTRAL BANK CASH HANDLING MODELS

	TRADITIONAL	RESTRICTED	SUPPORTED	ENGAGED
CURRENCY DESIGN & MANUFACTURE	✅ (design & manufacture supported by state and/or commercial printers/mints)			
ISSUE AND DISTRIBUTION	✅ Multiple CB branches throughout country with unrestricted access	✅ More limited CB branch network, restricted access hours, access limits	✅ More limited CB branch network restricted access hours, access limits, commercial sector contingency or additional depots or stores (see Annex J for details)	✅ More limited CB branch network restricted access hours, access limits, commercial sector contingency or additional depots or stores. Joint venture or utility with CB & commercial sector participants
RECIRCULATION OF FIT CURRENCY	✅ Unrestricted deposit and withdrawal, CB fitness sorting	❌ Restricted deposit and withdrawal, CB limited fitness sorting	❌ Restricted deposit and withdrawal, CB limited or no fitness sorting	❌ Restricted deposit and withdrawal, CB limited or no fitness sorting
RETURN OF SEASONAL SURPLUS CURRENCY	✅ Unrestricted deposit	❌ Restricted – limited to time windows, denominations, quantities, timeline between deposit and withdrawal	❌ Restricted – limited to time windows, denominations, quantities, timeline between deposit and withdrawal, off-balance sheet support	❌ Restricted – limited to time windows, denominations, quantities, timeline between deposit and withdrawal, off-balance sheet support
RETURN OF UNFIT CURRENCY	✅ Unrestricted deposit	✅ Unrestricted deposit, subject to full or partial sampling and 'fit in unfit' penalties	✅ Unrestricted deposit, subject to full or partial sampling and 'fit in unfit' penalties, off-balance sheet or return transport cost support	✅ Unrestricted deposit, subject to full or partial sampling and 'fit in unfit' penalties, off-balance sheet or return transport cost support
INTERBANK TRADING TO MEET SURPLUS/DEFICITS	❌ Not permitted or limited (informal local trading)	❌ Not permitted or limited (informal local trading)	✅ Permitted subject to guidelines or rules, settlement via CB	✅ Permitted subject to guidelines or rules, settlement via CB data exchange / forecasting to support trading / stock optimisation
OFF-BALANCE SHEET RELIEF / INCENTIVES	❌ Not usual	❌ Not usual	✅ Off-balance sheet relief for sorting and/or seasonal surpluses. Support for meeting fitness / quality standards	✅ Off-balance sheet relief for sorting and/or seasonal surpluses. Support for meeting fitness / quality standards potentially tied to reporting obligations

	TRADITIONAL	RESTRICTED	SUPPORTED	ENGAGED
PENALTIES	Not usual	Penalties for non-compliance (errors in deposits, fitness standard errors, forecasting errors, deposit and withdrawal within time limits, etc)	Penalties for non-compliance (errors in deposits, fitness standard errors, forecasting errors, deposit and withdrawal within time limits, etc). Penalties for off-balance sheet reporting / operational errors	Penalties for non-compliance (errors in deposits, fitness standard errors, forecasting errors, deposit and withdrawal within time limits, etc). Penalties for off-balance sheet reporting / operational errors. Penalties for reporting obligation errors
CURRENCY DESTRUCTION	Final authentication and destruction of unfit or withdrawn currency	Final authentication and destruction of unfit or withdrawn currency. Potential sample authentication and bulk destruction	Final authentication and destruction of unfit or withdrawn currency. Potential sample authentication and bulk destruction	Final authentication and destruction of unfit or withdrawn currency. Potential sample authentication and bulk destruction. Potential JV utility destruction under CB authority or supervision
COMMERCIAL SECTOR COUNTERPARTIES	Direct relationship with multiple financial institutions	Direct relationships with multiple (or restricted to principal financial intuitions)	Broader stakeholder engagement with financial institutions, cash logistics companies	Broader stakeholder engagement with financial institutions, cash logistics companies. Other stakeholder engagement across supply chain
ROLE OF CASH LOGISTICS / CIT COMPANIES	Transportation only, possible limited cash processing (coin and/or ATM replenishment / maintenance)	Transportation and some cash processing	Transportation and significant cash processing / management (financial institution cash processing often outsourced)	Transportation and significant cash processing / management (financial institution cash processing often outsourced). Possible JV utility operator or partner
INDUSTRY MARKET OVERSIGHT AND REGULATION	Limited engagement, usually restricted to financial institution counterparties	Limited engagement, usually restricted to financial institution counterparties, may extend to cash logistics companies	Broader engagement, but often on a voluntary basis with limited powers to intervein or direct outcomes	Broader engagement, formal market oversight or regulatory powers often backed by government regulation

ANNEX F: CONSIDERATIONS FOR DEVELOPING AN OFF-BALANCE SHEET OR CUSTODIAL INVENTORY

Counterparties and financial capacity

While the currency stocks held under off-balance sheet arrangements reside with the central bank, nonetheless steps are usually taken to ensure the financial integrity (and compliance with anti-money laundering and counter-terrorism financing legislation) of the commercial counterparties. The commercial organisations, therefore, usually need to have substantial financial capacity or to be backed by organisations that can meet the necessary capital and liquidity requirements.

For banknote arrangements, more often than not central bank contractual relationships are with commercial banks / depository institutions, even if the physical stocks are held at or operated by third party cash management companies. There are examples of central banks entering into direct relationships with cash management companies, for example the Bank of England has direct relationships with its NCS members which are cash management companies, although their financial obligations are still underwritten and backed by supporting financial institutions.

Premises and equipment

Invariably currency stocks need to be held at approved counterparty locations that meet robust security standards. Specific security standards for vaulting arrangements, chain of custody, camera observation, and alarm systems may all be prescribed as part of the operator and site approval.

Agreements may extend to the types of equipment used to verify and sort currency, this being tied directly to the agreement or part of broader banknote fitness standards.

Insurance and risk management

While the central bank assumes financial responsibility for currency stocks, it is usual for the site operator to commit to securing and insuring the currency stock in the event of theft, fire, or other hazards. Insurance coverage may be either for the lower replacement cost or full-face value of the currency held.

To minimise risks, the central bank may set out to formally review the cash centre operators' controls and risk mitigation policies and procedures.

Reporting, audit and inspection

Increasingly central banks set a range of reporting, audit and inspection obligations, both to ensure that currency stocks reported are accurate but also, increasingly, to monitor the overall health of the organisation. With increasing market consolidation of commercial sector cash handling in many countries, it is becoming ever more important to ensure that the cash supply chain remains resilient.

Currency types

Typically, off-balance sheet arrangements cover prescribed categories of banknotes or coin, or sometimes both. Invariably these categories need to be uniquely identifiable, so that if required they can be physically counted, audited, and the actual currency holding verified to the reported values.

Usually currency, as a minimum, will have had to be counted and verified on site, but may also have had to be sorted to ensure fitness and authentication. Some schemes are expressly designed to cover the sorting process, so may rely on initial bulk counting of sealed banknote packages and be subject to adjusted reporting once fine counting and sorting has been completed.

There will generally be a set cutoff period each day for reporting, which will influence receipt and processing times to ensure that the value of designated currency being held the off-balance sheet is maximised. The transfer of currency between one approved site and another and movement of currency to or from a site will be subject to specific rules, again safeguarding the ability to physically account for currency at any given time.

Central bank regulation of local recycling

While local recycling can be left to commercial market forces, a number of central banks have chosen to regulate and ensure standards are applied to ensure cash reissued is fit and counterfeit free.

ANNEX G: EUROSYSTEM RECYCLING LEGISLATION

Amongst the most developed of all cash recycling policies are those implemented by the European Central Bank (ECB) and the National Central Banks (NCBs) of the Eurosystem.

Enshrined in the Treaty on the Functioning of the European Union and the Statute of the European System of Central Banks and of the European Central Bank, the ECB has determined 'To protect the integrity of euro banknotes and enable a proper detection of counterfeits, euro banknotes in circulation must be maintained in good condition to ensure that they can be easily and reliably checked for genuineness, and therefore euro banknotes must be checked for fitness. Furthermore, suspect counterfeit euro banknotes must be quickly detected and handed over to the competent national authorities'.

To do so, the ECB enacted legislation in 2010 and has updated its policies since then to accommodate the new second series of euro banknotes introduced from 2013.

The key attributes of the legislation are that euro banknotes which have been checked for authenticity and fitness and classified as genuine and fit by trained staff members, but not by a machine, can only be recirculated over the counter. Euro banknotes may only be recirculated via customer operated machines or cash dispensers if they have been checked for authenticity and fitness by a type of banknote handling machine successfully tested by an NCB that is part of the Eurosystem, and found to be genuine and fit. Currently there are 12 NCBs across the 20 European countries that issue euro currency that provide testing facilities.

The Eurosystem has established common test procedures for various types of banknote handling machines. These tests check the ability of the machine to authenticate genuine euro banknotes and to separate genuine notes from counterfeits (the 'counterfeit detection test') and, if applicable, to sort euro banknotes according to their fitness for circulation (the 'fitness detection test'). For customer-operated machines, the proper functioning of the tracing system is also verified (the 'tracing system test'). This ties the verification of the banknote to the depositor using the device. The tests are conducted with collections of genuine and counterfeit euro banknotes.

The counterfeit detection test is conducted with a standardised test deck, which is composed of genuine euro banknotes, representative counterfeits found in circulation and 'additional documents', reproductions created by the Eurosystem that imitate certain properties of euro banknotes. Additionally, individual NCBs may use representative national counterfeits to consider the very latest developments in counterfeiting. The common test procedures and the regular updating of the test deck ensure that the use of recently discovered local counterfeits does not lead to a divergence in standards across national tests.

The ECB maintain a list of all equipment that has successful passed these tests and publishes this on its website. There are currently just over 500 different successfully certified customer operator or staff assisted machines listed.

ANNEX H: UK CODE OF CONDUCT FOR THE AUTHENTICATION OF MACHINE-DISPENSED BANKNOTES

Unlike the Eurosystem-wide legislation, the UK has opted for a voluntary code of conduct. First introduced following industry consultation in 2013, the Code is now in its third version.

To help maintain confidence in the currency, the Code requires banknotes from the Bank of England and Scottish and Northern Ireland note issuing banks which are dispensed through Customer-Operated Cash Dispensers (COCDs) to be either processed by the wholesale sector or authenticated by a machine which is listed on the relevant Framework for the Testing of Automatic Banknote Handling Machines.

The Code does not cover banknotes dispensed by hand, for example notes returned as change or cashback at staffed tills or paid out over a staffed bank branch counter.

The machines listed on the frameworks range from inexpensive point-of-sale authenticators to high-speed note sorters. All of them test a number of banknote security features quickly and simultaneously. While banknote quality sorting is not a requirement of the Code, it is strongly encouraged.

Amended frameworks were introduced in February 2021 to allow equipment manufacturers to self-certify the performance of their machines within their own facilities.

The code is based around four principles:

1. All Bank of England banknotes and Scottish and Northern Ireland issuing bank banknotes dispensed by COCDs must be authenticated using a machine listed on the relevant Framework for the Testing of Automatic Banknote Handling Machines.
2. Notes recycled and dispensed to the public must be authenticated as genuine.
3. Machines must be maintained in line with the manufacturer's guidance and use a software/firmware version which separates out 100% of known counterfeits. Staff must not bypass or modify counterfeit detection settings.
4. Internal processes must be sufficient to ensure the other three principles are adequately supported.

Companies operating COCDs must report their compliance to either the British Retail Consortium or LINK, the UK's ATM network.

The Bank of England and Association of Commercial Banknote Issuers testing framework sets out the types of equipment, along with the conditions for participation in the testing framework, the types of tests and testing procedures and subsequent reporting arrangements. Depending on the machine type (and size), testing can either be carried out at the Bank of England's facilities near London, the Test Provider site (in the case of the Scottish and Northern Irish banks), by arrangement at another site, or through self-certification by the manufacturer.

The Bank of England publishes a consolidated list of all successfully test machines on its website, which is updated on a monthly basis.

ANNEX I: COIN DEPOTS / TERMINALS AND STORES

In several countries, a first step to reducing central bank involvement in processing and recirculation is the setup of coin stores, which, given the typically much lower values of coin involved, is perhaps considered less sensitive and risky. Where coin issue is not a central bank function and handled by a country's Ministry of Finance and/or mint then cash management companies are much more likely to take on full responsibility for the distribution and recirculation of coin.

In the United States, where the central bank is an active participant in coin as well as banknote distribution, the Federal Reserve operates a coin terminal program. A coin terminal is a secure facility operated by a cash management company (armoured carrier) that holds central bank inventories of coin, and that receives deposits from and fulfils orders of coins for depository institutions on behalf of the Federal Reserve. Coin terminal operators are contracted directly by the central bank to perform these services.

In 2018, to supplement the armoured car company run coin terminals and as part of the Federal Reserve's effort to explore new solutions for improving the quality, handling, and distribution of coin, it established additional outsourced Coin Depot Services with a third-party vendor that was not an armoured carrier. Coin depots service Federal Reserve Bank customers that are not currently serviced by a coin terminal. There are approximately 175 coin terminals and depots across the United States.

In France, with coin being directly issued by the French Mint – Monnaie de Paris – from its production facility in Pessac, the Mint has established a number of dépôts auxiliaires de monnaies (DAMs) that are in cash management company depots to complement the country's banknote distribution arrangements.

RECONNAISSANCE

CASH SUSTAINABILITY FORUM™

Reconnaissance International Ltd
2.4 The Beacon, Beaufront Park
Anick Road, Hexham
Northumberland, NE46 4TU
United Kingdom
Tel: +44 (0) 1932 785 680
Email: publications@recon-intl.com
reconnaissance.net