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Impact of digital payments on greenhouse gas (GHG) emissions in India

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Foreword

Dear readers,

It is my pleasure to bring to you the latest edition of our payments newsletter. In this edition, we take a look at the impact of digital payments in India on GHG emissions. Furthermore, we have discussed the factors that cause carbon emissions and quantified the approximate savings in carbon emissions due to digital payments. Moreover, we have highlighted the decarbonisation initiatives currently being undertaken and recommended future course of actions that can be incorporated towards decarbonisation.

I hope you will find this to be a good and insightful read.

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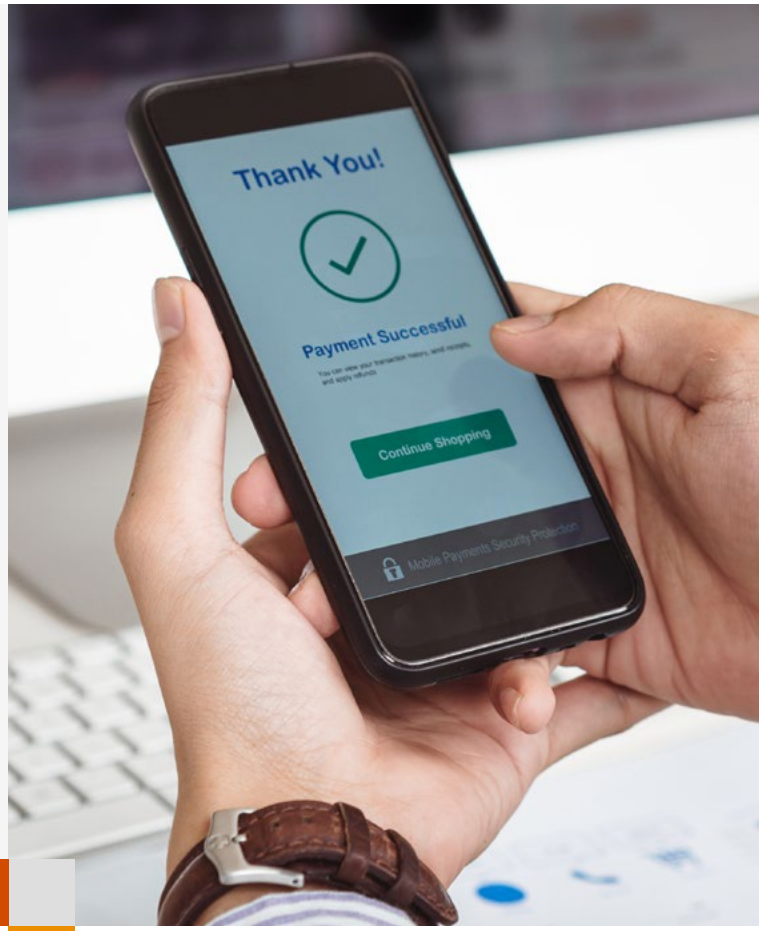
01 Introduction

The payments landscape in India has evolved significantly in the last few years due to the rapid adoption of digital payments. People are increasingly shifting towards digital payments due to their instant nature and convenience. Traditional methods of payment like cash, cheques and debit cards have either reduced or grown at a moderate pace in recent years, while newer innovative payment modes including Unified Payments Interface (UPI) are owning the majority market share with a wider penetration and user base.

As we embrace the exponential growth of digital payments, it becomes imperative to analyse the potential impact of digital transactions on the environment and GHG emissions. This is more relevant today than it was ever before because of climate change and the increasing focus of countries and regulators towards environmental challenges. In order to combat climate change, it is important to urgently incorporate sustainable practices in businesses. This can be done on a large scale if developing and developed economies collaborate and tackle this global problem together.

With reduction in cash and cheque-based payments in the payments landscape, carbon emissions due to fuel, energy and paper consumption have declined from a conceptual standpoint. However, a few digital payment modes involve electricity usage in devices such as point-of-sale (PoS) terminals and micro-ATMs as well as the energy demands of the data centres for processing, storage and transmission of digital transactions.

We analyse the correlation between the uptake of digital payments and their potential repercussions on GHG emissions. This assessment will cover both the positive and negative impacts through different payment drivers in the payments ecosystem. Moreover, we will aim to quantify the impact on carbon footprint due to the adoption of digital payments vis-à-vis traditional payments.



02 Overview of GHG emissions and their impact

Climate change is one of the most pressing challenges of our time and its impact on the world is becoming increasingly evident. One of the primary reasons for climate change is the excessive release of carbon dioxide (CO_2) and other GHGs into the atmosphere, largely due to human activities such as burning of fossil fuels, deforestation and industrial processes. This causes heat to trap in the Earth's atmosphere, known as the greenhouse effect, and increases global temperatures.

Current state of GHG emissions

Global emissions of GHG have reached alarming levels. As per the Global Carbon Atlas numbers, there were carbon emissions of 42 billion tonnes globally in 2020. This is primarily attributed to fossil fuel burning, changes in land usage and industrial activities. All these are major contributors to climate change which further leads to extreme weather events, rising sea levels and ecosystem disruptions.

The Paris Agreement 2015 is a global collaborative effort to tackle climate change. It is aimed at reducing the rise in global temperature below 2°C, with an objective to limit it to 1.5° by 2100. In line with this agreement, countries submit their respective action plans which are referred to as Nationally Determined Contributions (NDCs).

India is the third-largest greenhouse gas emitter and can play a vital role in order to tackle climate change. India submitted its first NDC in 2015, which is aimed towards reducing the emissions intensity by 35% of GDP, as compared to its 2005 levels. This goal was revised to 45% of GDP in 2021. Subsequently, this increased focus is now being reflected in the banking and payments industry in the country as well.

03 Digital payments landscape

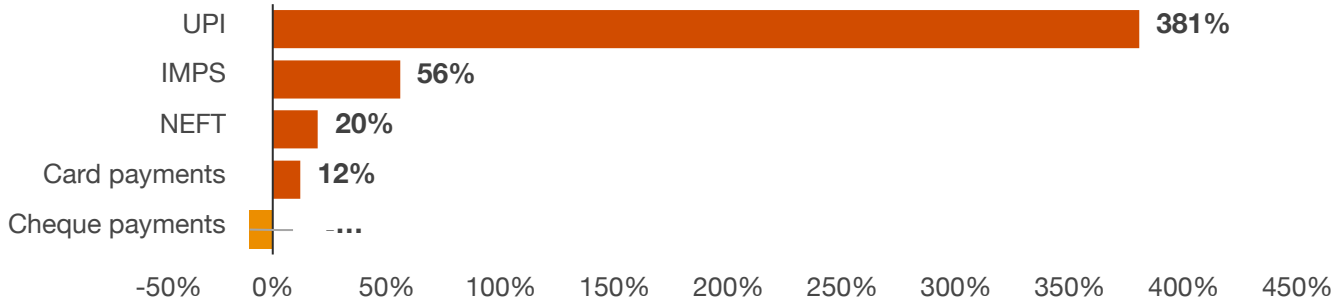
The digital economy, with the banking and payments sector as significant contributors, consumes substantial energy and has a large carbon footprint in the overall carbon emissions of India. The Indian Government, in collaboration with regulators, has made significant strides to bolster the infrastructure in the financial services space. These strides have led to an unprecedented growth in digital payments. This growth has economic, social and environmental impact which is discussed below:

1. **Economic impact:** Digital payments have led to economic growth through financial inclusion, transparency and efficiency.
2. **Social impact:** Digital payments are now reaching the underserved population in the country, which is expected to enhance social equity and reduce income inequality.
3. **Environmental impact:** Due to migration to digital payments, the need for physical infrastructure, paper consumption and transportation has come down, leading to a reduction in carbon emissions, thereby minimising the overall environmental footprint.

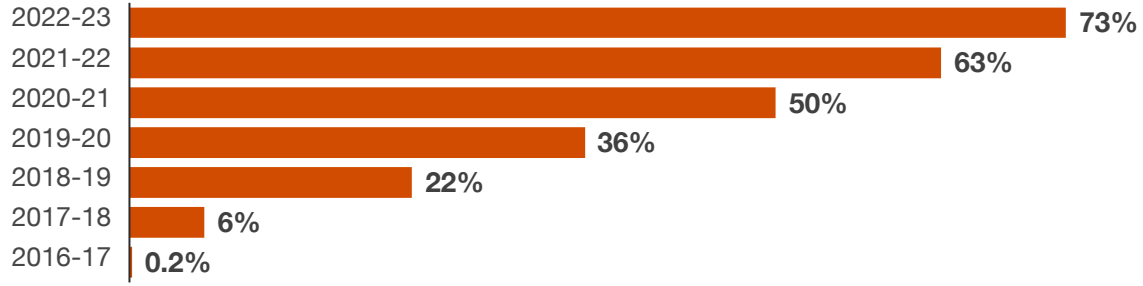
Growth in digital payments in India

India is one of the earliest adopters of digital payments, especially UPI, as it is one of the first few countries to implement digital payments at such a large scale. In India, UPI crossed 10 billion transactions (by volume) in a month for two consecutive months, as of September 2023. The graph below shows the compound annual growth rate (CAGR) by volume of different payments instruments in India between FY16–22 and UPI as a percentage of overall retail payments in India.

CAGR growth from 2016-17 to 2021-22



UPI as a percentage of total retail payments



03 Digital payments landscape

In addition to the rapid growth of UPI and IMPS of over 50%, there are other digital payments instruments like the National Electronic Toll Collection (NETC) FASTag, which has also gained significant traction. The transaction volume of NETC FASTag increased from 1.5 million transaction volume in 2017–18 to 120.7 million in 2021–22. Along with convenient toll payments, radio frequency identification (RFID)-based FASTag has significantly reduced congestion at toll plazas across the country. Likewise, other such digital payment initiatives such as AePS, NACH have also shown tremendous growth in the last five years.

These digital transformations in the payments domain are likely to have a significant impact on the environment. In the next section, we focus on mapping the GHG impact resulting from the digital payments ecosystem, an d critically examine whether this digital transition aligns with the broader global efforts to combat climate change while fostering economic growth and social inclusion.

04 Decarbonisation initiatives in financial services and payments industry

Although the global shift towards digital payments primarily garnered attention for its economic implications, digital payments also have the potential to mitigate carbon emissions.

Decarbonisation initiatives in financial services sector

While regulators and governments have been promoting green initiatives, leading banks and financial services companies are also taking measures towards reducing carbon emissions in their operations. Some key initiatives undertaken by different stakeholders in the ecosystem are outlined as follows:

- **Regulatory push:** Regulators worldwide are increasingly emphasising on mandating environmental, social and governance (ESG) reporting framework for companies. For instance, the Securities & Exchange Board of India (SEBI) has published Business Responsibility and Sustainability Report (BRSR) framework which mandates ESG disclosures for top 1,000 listed companies in India. The RBI is also pushing banks to incorporate ESG thinking into their decision-making process.
- **Paperless payments:** Technology has enabled the transformation of the payments mode to seamless and paperless payments. Essential banking processes like know your customer (KYC) and account opening have also become paperless now with the introduction of initiatives such as digital KYC, v-KYC and account aggregator.

  Another such initiative is where a leading financial services company is offering fee waivers and price discounts to customers who agree to switch to digital payments from paper-based payment services.
- **Sustainable products:** Banks and payment companies are evaluating green alternatives across the value chain such as eco-friendly materials for ATMs, PoS machines, credit/debit cards etc. Other products such as sustainability-linked financing, green guarantees and letter of credit for projects contributing to the environment are a few examples of initiatives towards sustainability.
- **ESG reporting by payment firms:** Leading payment processors have been voluntarily reporting their emissions through their annual sustainability reports. In these reports, companies announce their annual energy consumption for processing transactions and how they plan to reduce it.
- **Alternative technologies:** Financial institutions are deploying newer technologies to reduce their GHG emissions. Multiple banks in India are exploring renewable opportunities to run their branch operations. One of the leading private sector banks in India has deployed an Internet of Things (IoT)-based mechanism to set the air conditioners temperature basis the footfall in a branch. A few branches have also switched to backup systems powered by lithium-ion batteries replacing diesel generators.
- **Innovative products and tools for carbon assessment:** A leading payment processor along with a FinTech has launched a carbon calculator that allows payment cardholders to view the estimated carbon footprint of their card transactions. It provides users with the information and ability to make more environmentally conscious purchase decisions. Likewise, a leading Indian payments gateway is offering a carbon offset option. This offset will be paid by the customer towards reforestation or any other environment-related project.
- **Green investments:** International agencies such as Bank for International Settlements (BIS) have launched multiple green bonds over the years through which they pool funds from central banks and invest them in energy-efficient and renewable energy projects.

05 Decarbonisation assessment framework and methodology

This assessment aims at objectively measuring the impact of carbon emissions resulting from the rapid growth of digital payments in India. We conducted both qualitative and quantitative assessments across various parameters in the digital payments ecosystem.

To begin this study, we followed a comprehensive five-step framework with a bottom-up calculation approach. We identified key payment drivers that could potentially contribute towards GHG emissions, such as ATMs, payment cards, PoS machines, data centres etc. Thereafter, calculations were performed on GHG emissions across each of these payment drivers to analyse the overall impact of payment digitisation on GHG emissions. Apart from a quantitative analysis, a qualitative assessment was also done for the identified payment drivers using the RBI database and global benchmarks, along with use of primary research data for specific proxy calculations.

Decarbonisation assessment framework

	Identification of key payment drivers	Formulation of payments calculation model	Identification of GHG emission factors	GHG emissions model	Qualitative analysis
Objectives	• Establish the key payment drivers that lead to GHG emissions.	• Test initial hypothesis considered for each pillar identified in the previous step.	• Identify factors contributing to GHG emissions for each of the payment drivers.	• Compute overall GHG emissions for each of the payment drivers.	• Explain non-quantifiable factors leading to GHG emissions.
Activities	• Conducted secondary research for identification of these drivers • Stakeholder discussions and PwC payments expertise corroborated the results of secondary research	• Defined the initial hypothesis to be tested • Estimated trends across two periods namely pre- and post-demonetisation payments era • Computation of YoY growth rates and CAGR for aforementioned periods	• Secondary research to arrive at the factors that are leading to GHG emissions • Segregation of these factors for quantitative and qualitative analysis	• Calculation of GHG emissions at a unit level from quantitative factors • Extrapolate the emissions to the impact numbers from stage 2	• Analysis of factors qualitatively along with justification of why these factors cannot be quantified
	11 payment drivers	Impact numbers for emissions computation	Quantitative and qualitative factors	GHG emissions at an aggregate level	Qualitative model

Step 1: Identification of payment drivers

This step involved the identification of various payment drivers that contribute to carbon emissions.

This was based on secondary research, stakeholder interactions and our overall experience in this domain. We identified 11 key payment drivers that have been explained further later in the newsletter. Although there may be other payment drivers as well that impact carbon emissions, we have only considered 11 for this study.

05 Decarbonisation assessment framework and methodology

Identified payment drivers

	ATMs		e-KYC		Coins		Bank cards
	Bank notes		Branches		Data centres		Cheques
	QR codes		Micro-ATMs		PoS machines		

Step 2: Formulation of the payments calculation model

We formulated an initial hypothesis regarding the impact of digitisation on the payment drivers – i.e. whether digitsation led to an increase or decrease in carbon emissions. Comprehensive calculations were conducted to test these hypotheses.

For this assessment, we tested the hypothesis on a ten-year timeframe (from FY12 to FY22) divided into two periods, namely the pre-demonetisation era (2012–16) and post-demonetisation era (2017–22). The rationale behind this segmentation was the exponential surge in digital payments from 2017.

In order to present a comparative analysis of these two periods, CAGRs for both periods were calculated. Thereafter, we extrapolated the post-demonetisation era using the CAGR of the pre-demonetisation era. This helped in understanding the difference between the actual numbers in the post-demonetisation era vis-à-vis what those numbers would have been without the rapid growth of digital payments. For instance, if ATMs increased by 20% CAGR in the pre-demonetisation era, then we used this 20% to arrive at the numbers for the post-demonetisation era. Certain proxies were also taken to achieve more accurate approximations.

Step 3: Identification of GHG emission sources

In this phase, we identified the factors leading to GHG emissions for each of the payment drivers, by utilising secondary research and our GHG expertise. The most common GHG emissions included in the study are paper usage, fuel consumption, electricity usage and raw material consumption across each of the payment drivers.

These factors were further divided into quantitative and qualitative factors. Detailed calculations were performed on quantitative parameters while qualitative analysis was conducted on other parameters without any detailed numerical computations.

05 Decarbonisation assessment framework and methodology

GHG emission sources

Paper consumption: Paper used in PoS and ATM receipts, cheque-based payments, currency notes, KYC documents etc.

Fuel consumption: Fuel consumed during journeys made for movement of cash, power backup for running facilities

Electricity consumption: Electricity used in running facilities like bank branches, ATMs, data centres, printers

Raw material consumption: Raw materials used in manufacturing like plastic used in debit/credit cards, steel used in bank coins, etc.

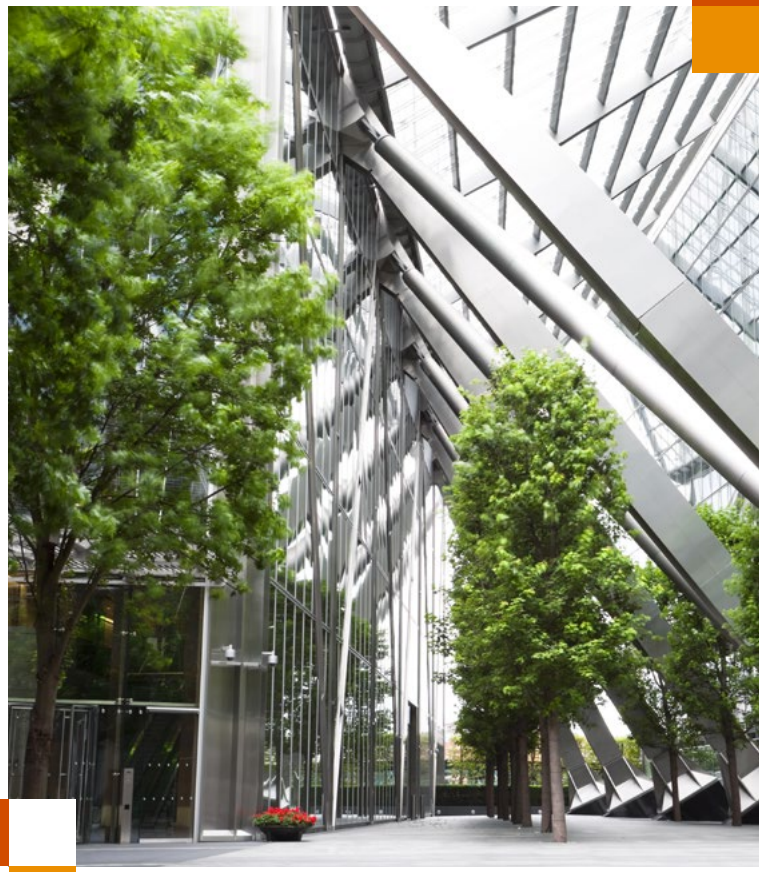
Step 4: GHG emissions model

By leveraging the unit dynamic calculations for payment drivers and GHG emissions, we computed the consolidated GHG emissions for each payment driver in this step. At an aggregate level, the sum of emissions calculated for individual payment gives an overall picture of the impact of digital payments on decarbonisation.

Step 5: Qualitative analysis

Lastly, a qualitative analysis was done for all the payment drivers to identify additional factors that lead to GHG emissions. Some of these qualitative factors are fuel consumption during journeys made by customers, raw material used in the construction of bank branches, electricity consumption in running printers to print currency notes, cheques, account opening forms etc. These factors cannot be quantified due to the lack of credible data/information or their comparatively small impact on the overall emissions.

Finally, we could determine the overall impact (positive, negative, neutral) of digital payments on decarbonisation.



06 Impact assessment

After identification of payment drivers and the respective emission factors associated with them, this section will elaborate on our hypotheses, approach taken and the overall impact in terms of emissions for these payment drivers.

Payment drivers

- Reduction in ATMs
- Introduction of digital KYC
- Banknotes in circulation
- Coins issuance
- Reduction in bank cards
- Low growth in bank branches
- Increase in data centres
- Increase in QR codes
- Decrease in cheque payments
- Increase in PoS machines
- Increase in micro-ATMs

Emission factors for payment drivers

	ATM	e-KYC	Bank Notes	Coins	Bank cards	Bran-ches	Data centres	QR codes	Che-ques	PoS mach-ines	Micro-ATMs
Paper consumption	✓	✓	✓		✓	✓		✓	✓	✓	✓
Raw material consumption			✓	✓		✓				✓	✓
Electricity consumption	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fuel consumption	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Plastic consumption					✓			✓		✓	✓
Metal consumption					✓						
Energy consumption							✓				

06 Impact assessment

1. Reduction in the number of new ATMs

Our hypothesis for ATM was: Without digital payments, the number of ATM deployments in India would have increased exponentially resulting in a larger share of CO_2 emissions from ATM operations.

To test this hypothesis, we compared the pre-demonetisation and post-demonetisation eras for ATM deployments and estimated the increase/decrease in ATM deployments.

We also conducted a unit-level analysis of GHG emissions per ATM. Based on the detailed calculations, we estimated an avoidance of up to **nearly 8 million tCO_2** of GHG emissions due to reduction in ATM deployments, which is a significant **positive impact** on decarbonisation.

2. Introduction of digital KYC

The hypothesis was: With the increased adoption of digital KYC process, online account opening process has led to the reduction in carbon emissions in the post-demonetisation era.

We considered the total number of deposit and loan accounts in scheduled commercial banks in each year from 2012 to 2022.

We conducted a unit-level analysis of GHG emission factors and our calculation suggests that GHG emissions have significantly reduced due to rapid growth of digital KYC initiatives in India such as video KYC, account aggregator, DigiLocker etc. According to the calculations, carbon emissions reduced in the post-demonetisation era because of the introduction of digital KYC process that stands at about **22k tCO_2**, which is a **positive impact** on decarbonisation.

3. Banknotes in circulation

We have considered banknotes in circulation as a payment driver for this assessment. However, a key point to be noted here is that banknote printing and circulation depends on multiple macro factors and digital payments may not directly impact the circulation of banknotes.

Despite the dominance of digital payments, banknotes still hold a significant share in the payments landscape. However, cash transactions as a percentage of the overall payments volume have decreased in India in the last few years, from 91% in 2017 to 59.3% in 2021.

We have not included banknotes in our calculations primarily due to the fact that the banknotes serve a broader purpose in an economy, which goes beyond the purpose served by digital payments.

4. Coin issuance

Coin usage in the pre-demonetisation era was largely for low-value transactions, and customers used to receive it as loose change during their day-to-day cash transactions. However, with the rapid growth of UPI, merchants are increasingly paid digitally, eliminating the need for loose change. Additionally, low-value payments are being made by UPI that has led to a decreased usage of coins.

Our hypothesis was: The circulation of coins has decreased significantly after UPI which has in turn reduced carbon emissions significantly.

To test this hypothesis, we have analysed the data for coins in circulation in both pre- and post-demonetisation payments eras.

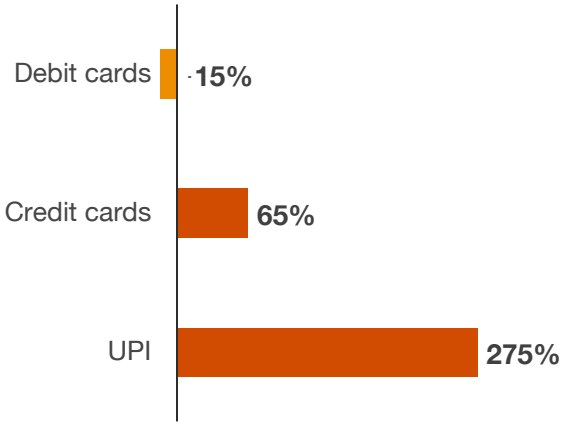
For computation of GHG analysis, we considered multiple factors that caused emissions. Final calculations suggest a reduction in GHG emissions of about **520k tCO_2**. This has a significant **positive impact** on decarbonisation.

06 Impact assessment

5. Reduction in bank cards

Payments using debit cards were trending in the pre-demonetisation payments era. However, this trend has decreased in the past few years, with the adoption of UPI. Credit card payments are growing at a decent pace, but continue to lag behind UPI.

Growth in transaction volumes (FY21 to FY23)



Our hypothesis was: Debit and credit cards would have grown at a much higher pace without UPI, resulting in a larger share of carbon emissions.

At an aggregate level, due to digital payments, the pace of growth of cards has reduced, which has led to GHG emissions savings of up to about **20k tCO_2**, as per PwC's analysis. This is a significant **positive impact** on decarbonisation.

6. Low growth in bank branches

Bank branches play a crucial role in offering general banking services. However, primary research and stakeholder discussions indicate that a vast majority of customer visits to branches are related to payments. While urban customers have reduced their dependency on branches with the adoption of digital services, rural and semi-urban customers still heavily rely on physical branches for the required support.

To promote financial inclusion and fulfil customer needs, banks have started to expand into rural areas. Thus, there is a stagnancy in the growth of urban branches, whereas branch expansion is ongoing in the rural and semi urban areas.

Our hypothesis here was: Without digital payments, the number of bank branches would have increased significantly, resulting in a larger share of carbon emissions.

In our calculations, we have observed a modest CAGR of 2% in the post-demonetisation era as compared to 7% in the pre-demonetisation payments era.

At an aggregate level, the de-growth in number of bank branches due to digital payments has resulted in saving of GHG emissions up to nearly 650k tCO_2, as per PwC's analysis. This is a significant positive impact on decarbonisation.

7. Increase in data centres

Data centres are used for storing data related to transactions in data server machines. Storage requirements in data centres have increased with the increase in the volume of digital transactions. The unprecedented growth of digital payments in the last few years has led to the additional demand for data centres.

Our hypothesis was: Due to increasing digital payments, there is a need for more data centre storage which would lead to a significant increase in GHG emissions.

For computation of carbon emissions, we considered proxies like energy consumption per transaction using the data published by global payment processors in their annual reports. We have further applied these proxies to the retail digital payments transactions over 2012–23 (IMPS, NACH, UPI, APBS, cards, UPI, NEFT).

As per the analysis, there is an increase in data storage due to digital payments, which has led to additional GHG emissions of up to **-25k tCO_2**. This is a significant **negative impact** on decarbonisation.

8. Increase in QR code use

With increasing penetration of UPI payments in India, the need for QR codes have increased significantly. However, this has led to a negative impact on decarbonisation since carbon emissions associated with QR code paper printing have increased.

06 Impact assessment

Our hypothesis was: GHG emissions have increased due to an increase in QR codes in India to support the trend of rising digital payments.

To test this hypothesis, we have taken the number of QR codes (Bharat QR + UPI QR) from 2019 to 2022.

As per our analysis, increase in QR codes due to digital payments has resulted in additional GHG emissions of up to **-60k tCO_2**. This shows a **negative impact** of QR codes on the decarbonisation initiative.

9. Decrease in cheque payments

The use of cheque-based paper payments has reduced significantly in the era of digital payments. The number of cheques issued in 2016–17 was 1,206 million, which has reduced to 699 million as of 2021–22 – a reduction of 10% CAGR in six years.

Our hypothesis was: Payments through cheques have decreased over the years, because of customers switching to digital payments in India and hence paper usage is also reduced.

To test this hypothesis, we compared the volume of cheque-based payments in the pre- and post-demonetisation eras.

At an aggregate level, the reduction in cheque payments have resulted in modest savings of GHG emissions of **nearly 50 tCO_2**.

10. Increase in PoS machines

There was a phenomenal growth of PoS terminals across the country initially. However, this stagnated with the introduction of UPI. Retail stores are now using a UPI QR code to receive payments instead of a PoS machine due to high merchant charges involved in PoS transactions.

Our hypothesis was: PoS machines would have increased significantly in the post-demonetisation era without UPI and resulted in increased carbon emissions.

To test this hypothesis, we calculated the number of PoS machines. The calculations showed that PoS terminals in circulation increased by 16.1% in the post-demonetisation payments era, against 22.5% in the pre-demonetisation payments era.

As per PwC's analysis, GHG emission savings because of the decrease in the pace of growth of PoS machines stands at nearly **10k tCO_2**. This is a modest **positive impact** towards decarbonisation.

11. Increase in micro-ATMs

Micro-ATM is an advanced version of PoS machines. It allows basic banking operations like cash withdrawal and balance inquiry at places where ATMs are not available.

Our hypothesis was: Micro-ATMs have grown at a high speed which has added to the carbon emissions in India.

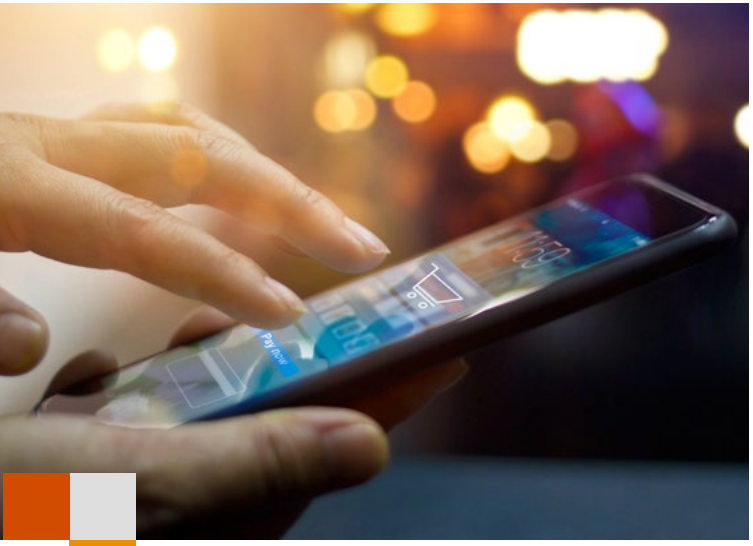
To test this hypothesis, we have taken the number of micro-ATMs from 2018 to 2022 to estimate the pace of growth. We observed a CAGR of 55.6% in micro-ATMs in this five-year period.

At an aggregate level, the added carbon emissions due to increase in micro-ATMs stands at about **-400 tCO_2**. This is a **negative impact** of micro-ATMs on carbon emissions.

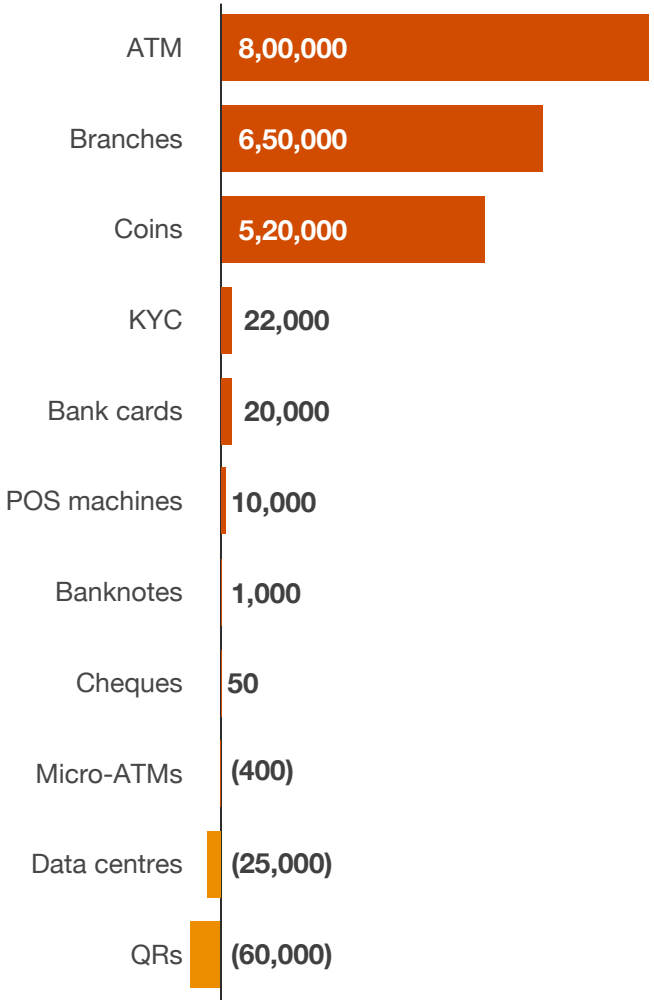
07 Conclusion

The overall impact of digital payments on carbon emissions is positive when considering the combined carbon emissions across 11 payment drivers. ATMs, branches and coins are the key drivers, contributing significantly to the reduced GHG emissions in the post-demonetisation era. While increase in data centers has increased the carbon emissions, the impact is significantly lower as compared to the positive impact by other payment drivers.

Over five years, there have been substantial savings of about 10 million tCO_2 GHG emissions after the rise of digital payments in India. The graph below shows the individual emissions (either saved or added) for each of the identified payment drivers.



GHG emission avoidance in tCO_2



Financial institutions in India and across the work are taking initiatives to curb GHG emissions by setting targets and taking proactive measures to achieve them. **While these initiatives are being opted for by a few players in the space, there is a need for joint efforts by the industry stakeholders as well. This will require innovative practices to be adopted by different players in the ecosystem**.

Some of the leading industry practices to reduce carbon emissions are usage of credit cards made from sustainable material, tracking of carbon emissions on frequent intervals and taking corrective actions to meet the annual emissions target, taking cognisance of the energy consumed in data centres and how it can be reduced.

To sum up, there should be relevant interventions towards reducing carbon emissions and collaborative efforts should be encouraged that include all stakeholders. Focus on ESG becomes even more important in response to changing customer preferences towards eco-friendly financial products. Therefore, a proactive approach is required, with an emphasis on tracking carbon emissions regularly and taking corrective actions to meet ESG targets.

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