

Worldline Belgium-based study confirms digital transactions are greener than cash

The report maps the path to a CO2-optimised payment ecosystem

NOTES FOR EDITORS.

The '*Accelerating the Decarbonisation of payments*' study aims to quantify and compare the CO₂e emissions related to different payment methods (cash, cards, smartphones) for in-store and online transactions. Commissioned by Worldline, the report also seeks to identify potential levers which could contribute to further reduce the carbon footprint of a payment transaction, as part of the payment industry's contribution to the Fit for 55 ambition of the European Green Deal.

The report who applied a Life Cycle Analysis (LCA) methodology sponsored by Worldline, was prepared by Patrice Geoffron, Professor of Economics at the Paris Dauphine-PSL University.

The report analyses the full end-to-end value chain of a digital payment transaction, from the use of the card to the validation of the transaction. It covers the entire payment ecosystem including banks, network providers and terminal manufacturers.

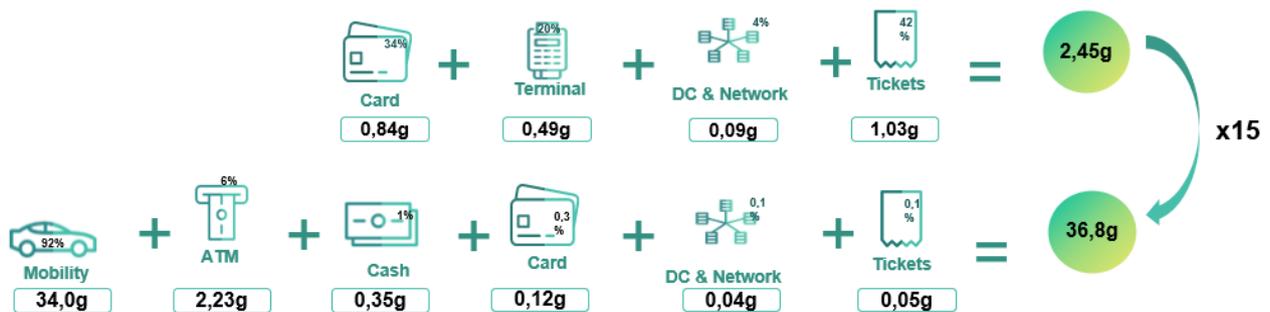
To ensure data consistency, the study was carried out on payment transactions in Belgium, where Worldline is a leading payment processor.

Key findings of the report include:

In-store cash transactions generate a lot more carbon emissions.

- A single cash transaction is estimated to emit 36.8g of CO₂e, including mobility (see graph 1), compared to 2.45g for a card payment. From a carbon footprint standpoint, in-store digital payments are far more efficient.
- A cash transaction (based on one cash withdrawal providing on average the cash for 7 individual payments), emits 15 times more CO₂e emissions than a corresponding in-store digital payment transaction. This is mainly due to the CO₂e emissions linked to the supply and sourcing of the physical cash, including use of transport. This accounts for 34g of CO₂e emissions.
- Even without the emissions related to the individual mobility required to withdraw cash from ATMs, the CO₂e emissions of a cash transaction are estimated to be 2.8g. This is 14% more CO₂e emissions than the current estimated 2.45g of an in-store digital payment transaction.
- In the cash-based transaction process, most of the emissions are derived from the physical nature of the cash which needs corresponding physical infrastructure and especially ATM infrastructure including a safe box, a PC, a screen and dedicated buildings and facilities. The associated emissions of the ATM are 2.23g of CO₂e, which represents 80% of the total emissions of the cash transaction, excluding the mobility component.
- The report's estimates of the CO₂ emissions of a cash transaction do not include the additional CO₂e emissions related to the post-payment transactions processes which merchants use to manage the cash accumulated after their daily transactions, such as security investments, dedicated storage, physical transfers to the bank or secure transport services provided by specialised firms.

- The report concludes that the steady adoption of digital payments in Europe, and the decreasing use of cash and cheques, is contributing directly to helping the continent meet its CO2e reduction ambitions.

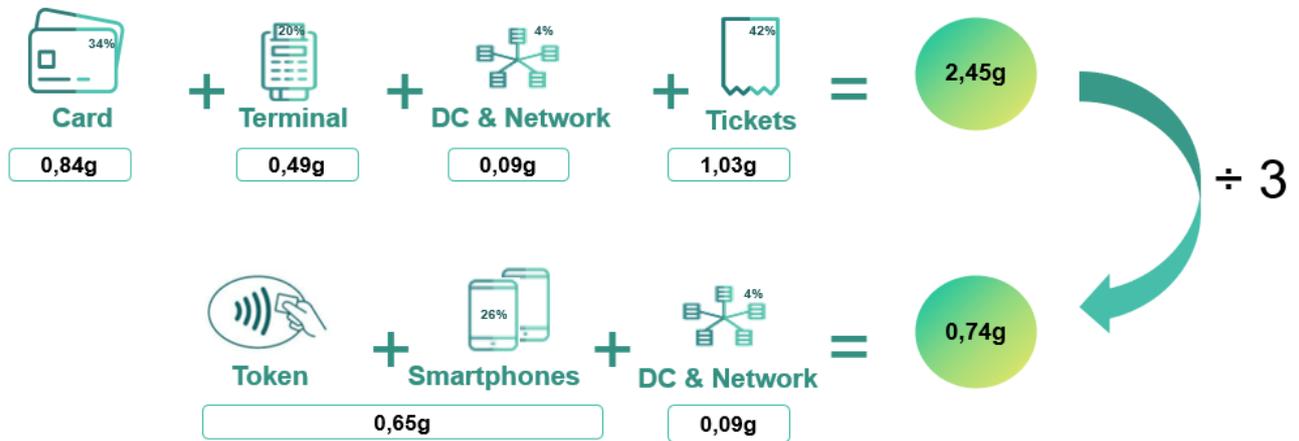


Graph 1: comparison of an in-store digital payment transaction to a cash transaction (in grammes of CO2e emissions).

In-store digital transactions could generate even less carbon emissions than today.

- At present, the bulk of CO2e emissions generated by in-store, card-based digital payment transactions are related to the physical components in the transaction process such as the paper receipt, the plastic card and the payment terminal.
- The main emissions factor arises from the double printing of transaction receipts, with 1 receipt for the merchant and 1 for the payer. These represent 42% of the emissions, or 1.03g of the 2.45g total (see graph 2).
- The other physical components of the value chain, such as the plastic card and the payment terminal, represent 1.33g of CO2e emissions, of which 0.84g is generated by the card (34%) and 0.49g by the terminal (20%).
- The IT processing activities in modern data centres and networks are the smallest contributor to emissions, producing only 4% of the total emissions of a digital transaction [at 0.09g]. Due to the concentration and mutualisation of modern data centres where billions of transactions are processed each single transaction represents only a very limited level of CO2e.
- There is significant potential to reduce these CO2e emissions substantially. By no longer printing paper receipts, replacing the card with a virtual card hosted on a smartphone, and replacing the merchant payment terminal by a merchant smartphone, CO2e emissions could decrease to 0.74g of CO2e compared to the current 2.45g for the traditional card-based digital payment.
- In this optimised payment scenario, the remaining 0.74g of CO2e would be largely attributable to the 2 smartphones involved. These devices would represent 0.65g of CO2e per transaction, mainly reflecting the high environmental costs of their manufacture.

- Since August 2023, in compliance with French anti-waste legislation, it has no longer been mandatory for merchants in France to print paper receipts for most products and services.



Graph 2: the CO₂e footprint of an in-store digital payment transaction, before and after optimisation (in grammes of CO₂e emissions).

Online digital transactions: the future is smartphone authentication.

- In Belgium, consumers use a dedicated physical device specific to the Belgian market to manage customer authentication. This represents 75% of the emissions of the online payment transaction, producing 8.9g of CO₂e emissions compared to the 11.9g of CO₂e emissions of the entire transaction (see graph 3).
- As with in-store digital payment transactions, several optimisation measures can easily be implemented to reduce the carbon footprint of online digital transactions. For example, eliminating the dedicated authentication device would reduce the footprint of a transaction to an estimated 3g of CO₂e.
- The virtualisation of the credit card through payment tokenisation and the use of upstream security authentication would deliver a further reduction of 2.2g of CO₂e. This would reduce the carbon footprint of the online transaction to less than 1g (0.8g), a potential reduction of 93% compared to the existing online payment transaction.
- To reduce CO₂e emissions from online payment transactions, the greatest impact will come from replacing physical cards and specific authentication devices with smartphones when making and authenticating online payments.



Graph 3: the CO₂e footprint of an online digital payment transaction, before and after optimisation (in grammes of CO₂e emissions).

Recommendations for less carbon in payments.

The report confirms that actions already taken by some governments in Europe are welcome levers for cutting quickly, and at no additional cost, the CO2e emissions of a payment transaction. These actions include limiting the printing of transaction receipts for card holders and reducing cash usage by supporting in-store contactless transactions.

The report recommends the following carbon optimisation measures to be adopted by different players across the European payment ecosystem:

1. **Regulators** to end the requirement for the mandatory printing of payment receipts for a transaction;
2. **Banks** to provide digital tokens to virtualise payment cards, rather than relying on plastic cards; and
3. **Merchants** to adopt smartphone-based solutions which support digital payment transactions.

ABOUT WORLDLINE

Worldline [Euronext: WLN] helps businesses of all shapes and sizes to accelerate their growth journey – quickly, simply, and securely. With advanced payments technology, local expertise and solutions customised for hundreds of markets and industries, Worldline powers the growth of over one million businesses around the world. Worldline generated a 4.6 billion euros revenue in 2023.

Read our [2022 Integrated Report](#)

Worldline's corporate purpose ("raison d'être") is to design and operate leading digital payment and transactional solutions that enable sustainable economic growth and reinforce trust and security in our societies. Worldline makes them environmentally friendly, widely accessible, and supports social transformation.

ABOUT PATRICE GEOFFRON

Patrice Geoffron holds a doctorate in industrial economics and is a professor at Université Paris-Dauphine-PSL, where he was interim president and international vice-president. He was also the founding director of the Dauphine Economics Laboratory (LEDa). Among other scientific responsibilities, he is a member of the Scientific Council of the CEA and Engie, as well as the Cercle des Économistes. Previously, he was a member of the World Council of the International Association for Energy Economics, and an expert on the Citizens' Climate Convention. He is co-editor of the journal Economics and Policy of Energy and the Environment and a member of the editorial board of the International Journal of Management and Network Economics.

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