Access to Contactless Payments: Informing Use for Electric Vehicle Charging

Global Research & Recommendations

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EXECUTIVE SUMMARY

This report analyzes the growth and adoption of contactless Europay MasterCard Visa (cEMV) payments globally, with a specific focus on implications for regulating payment method requirements at electric vehicle (EV) charging stations and the adoption of contactless payments at charging infrastructure for zero-emission vehicles across California. Our research indicates an increase in the adoption of contactless payment methods in the surveyed countries, encompassing both everyday transactions and transit-related expenses. At the same time, contactless payments are highly regarded by users, with an increasing interest in advanced payment methods that support them, such as mobile wallets.

The research underscores the impact of global payment market trends, mandates, and other initiatives in driving the uptake of contactless payments. The COVID-19 pandemic has further accelerated the adoption of contactless payments, and governments have responded by raising transaction value limits for contactless payments to accommodate a broader range of transactions.

Based on the findings, we provide several threshold recommendations that would ensure contactless-only payments are not a barrier to paying for EV charging, as seen below:

- Over 70% of all card transactions are contactless
- In high-traffic locations like convenience stores, 70% of all transactions are contactless

We propose the following recommendations based on the completed research for contactless penetration and survey results on card usage and barriers to electric vehicle charging:

- The optimal equity outcome is fewer barriers for lower-income communities. Contactless payment seems to be meeting these needs. As such, **regulatory bodies in California can create continuity on Senate Bill (SB) 123 regulation around the use of contactless payment for electric vehicle charging at a station.**
- The State and local agencies need to **facilitate financial access to those without contactless payment.**

INTRODUCTION

The California Air Resources Board adopted the Electric Vehicle Supply Equipment Standards Regulation in 2019, in accordance with Senate Bill 454 (Corbett, Chapter 418, Statutes of 2013), with the goal of reducing barriers to accessing public charging stations. This regulation includes the following provisions:

- Minimum requirements for payment methods a public charging station must accept.
- Facilitates roaming agreements between electric vehicle service providers.
- Creates a more complete database of location and pricing information for consumer use.
- Ensures clarity on the cost of a charging session, among other directives.

This regulation is designed to serve not only current electric vehicle drivers but also the future generations of Californians who will use these charging systems. In 2022, CARB conducted an Electric Vehicle Supply Equipment Standards Technology Review that highlighted the need for continued monitoring of the payment's technologies ecosystem. This is necessary due to the rapid evolution of new payment methods, including contactless payments and mobile wallets. The review emphasized the importance of gathering insights from drivers with varying income levels and access to traditional banking services to ensure inclusivity and equity in payment technology requirements on charging stations.

In the ever-evolving digital landscape, all aspects of the financial industry have undergone numerous changes. Whether it's the way people get onboarded in the banking system or the products available to both consumers and businesses to meet their daily financial needs, the modernization of the way we do business has been at the forefront of recent efforts aimed at improving the user experience. Perhaps the way we make payments has experienced the most monumental transformation. As traditional purchasing methods gradually take a backseat, a new paradigm has emerged, promising a seamless and secure payment experience: contactless payment technology.

Contactless payment technology, also known as "tap-and-go," is an innovative payment technology that enables transactions by using a contactless interface. Traditionally, contactless payment technology, known in the banking industry as Euro MasterCard Visa (EMV) chip, refers to the globally recognized standard for secure payment transactions using smart cards, which incorporates embedded microchips into payment cards, enhancing security and mitigating fraud risks. Contactless payment technology builds upon this foundation by introducing a wireless communication feature, enabling users to make payments by simply tapping or waving their EMV-enabled card or mobile device near a contactless reader.

Contactless technology uses near-field communication or radio-frequency identification technology, which are short-range wireless communication protocols, to enable fast and convenient transactions by simply tapping or waving a payment card, smartphone, or wearable device near a contactless-enabled terminal. Contactless payment technology has

revolutionized the way we interact with payment terminals, and that is due to one of its primary advantages: its speed. The introduction of chip cards offered numerous advantages from a security standpoint compared to their predecessor, magnetic stripe cards.

When chip cards were first introduced, they allowed a liability shift from the card issuer to the party with the least secure technology, encouraging financial institutions, merchants, and payment processors to upgrade their systems to avoid the high costs of fraudulent transactions. To ensure global rollout and speed standardization, the major payment networks - Europay, Mastercard, and Visa - collaborated to develop the chip card requirements common around the world today.

While traditional chip cards require insertion into a chip reader, contactless transactions use the chip's capabilities to transmit encrypted payment data. Using contactless payment technology, transactions can be completed in a matter of seconds, significantly reducing wait times and enhancing customer convenience, particularly in high-volume environments such as retail stores, public transportation, entertainment venues, and more. Security is another key aspect of contactless payments. The technology incorporates robust security features, such as encryption, which protects sensitive payment information from unauthorized access or interception and makes the system less vulnerable to skimming. Skimming occurs when criminals illegally install devices, known as skimmers, on ATMs, point-of-sale terminals, or fuel pumps capture to data or record cardholders' PINs. Criminals then use the data to create fake debit or credit cards and then steal from victims' accounts.

All these characteristics have made contactless payments popular worldwide, making it increasingly supported by a vast network of payment terminals and merchants. Businesses are also embracing contactless-enabled point-of-sale terminals to cater to the growing demand for this payment method. Further, contactless payments are not limited to physical payment cards, as users can easily use this technology through mobile payment solutions such as digital wallets. By storing payment card information securely on smartphones or wearable devices, users can make contactless payments by tapping their device on a contactless reader.

From a security perspective, contactless payment technology also offers many inherent advanced security features, such as dynamic encryption, tokenization, and transaction-specific codes. Moreover, it is more adaptable and easier to integrate with other technological advancements, like biometrics or mobile payment solutions. For the end user, the benefits are obvious. Contactless payment enhances customer convenience, allowing for seamless, faster, and frictionless transactions.

As contactless payment technology finds its way into the payment industry and becomes progressively popular among consumers, governments are called to rethink their regulation of payment methods, especially those that explicitly call out chip-based payment requirements.

We ask: the benefits of contactless payments are hard to ignore, and uptake continues to accelerate**, so when is it time for governments to rethink payment requirements that**

refer to chip cards? Is the uptake of contactless payment inevitable, and currently dominant to a degree that we must amend regulation? What can we define as the threshold for this?

Questions like these are crucial for the State of California as it regulates the rollout of electric vehicle chargers with the goals of increasing zero-emission vehicle uptake and ensuring access for all, including among low-income communities. The exclusion of contactless payment as a payment method for public charging stations could suggest that the adoption of sustainable alternatives is potentially hindered. Making sure that the infrastructure works for a large portion of the Californian population is a key outcome for CARB, will accelerate electric vehicle uptake, and ensure the implemented solutions do not impose undue hardship on any Californians.

This report analyzes the growth of contactless payments globally, highlighting statistics on usage, drivers that pushed the uptake of this payment method, and other initiatives -- driven both by the private market and governments -- to support it. Where data is available, statistics on transit, vehicle fueling, and gas station payments are also featured to create a better understanding of the rise of contactless payments in the mobility landscape. This research aims to understand the contactless payments share in the global market and the level at which they represent a significant enough portion of the payments market to consider contactless-only payments as not being a significant barrier to users.

The analysis contains data on ten countries located in North America, South America, Europe, Asia, and Australia. The following section showcases the findings of this research, containing:

- Statistics on contactless payment rollout and uptake
- Statistics on contactless payment rollout and uptake in mobility (public transit and gas stations)
- Other information on contactless payment uptake among the investigated countries, such as:
    - User behavior and satisfaction
    - Private market trends for each of the investigated regions relevant to the uptake of contactless payment
    - Other drivers that could potentially boost contactless payment use, including but not limited to the COVID-19 pandemic, country-specific regulatory developments, and more.

Following this, the report proposes recommendations on defining an adequate access model for contactless and other relevant conclusions.

GLOBAL RESEARCH

Research methodology: data framework

Statistics on contactless payment uptake are an easy way to quantify its use. These statistics provide information on the current market size, penetration, and growth, the portion of the contactless payment market in contrast to other—alternative or supplementary—payment options, and they inform potential business strategy and investment decisions. However, this information is not enough to fully understand the market or measure the effects of potential developments in the industry. As such, to capture the full contactless payment story, we developed a framework that will incorporate research findings across four categories:

- **Contactless** payment **transaction statistics**, which could be expressed as any of the statistics below, from most to least relevant:
    - Percentage of contactless payment as part of all face-to-face transactions
    - Percentage of contactless payment as part of all card-based transactions (credit and debit)
    - Percentage of contactless payment as part of all transactions
    - Percentage of contactless payment in specific stores (e.g., convenience, food and beverage)
    - Percentage of payment cards in circulation that are contactless

- **User behavior and satisfaction**, which could be expressed as any of the statistics or survey data below:
    - Percentage of users using contactless payment over other payment methods
    - User satisfaction metrics for contactless payment
    - Changes in payment behavior

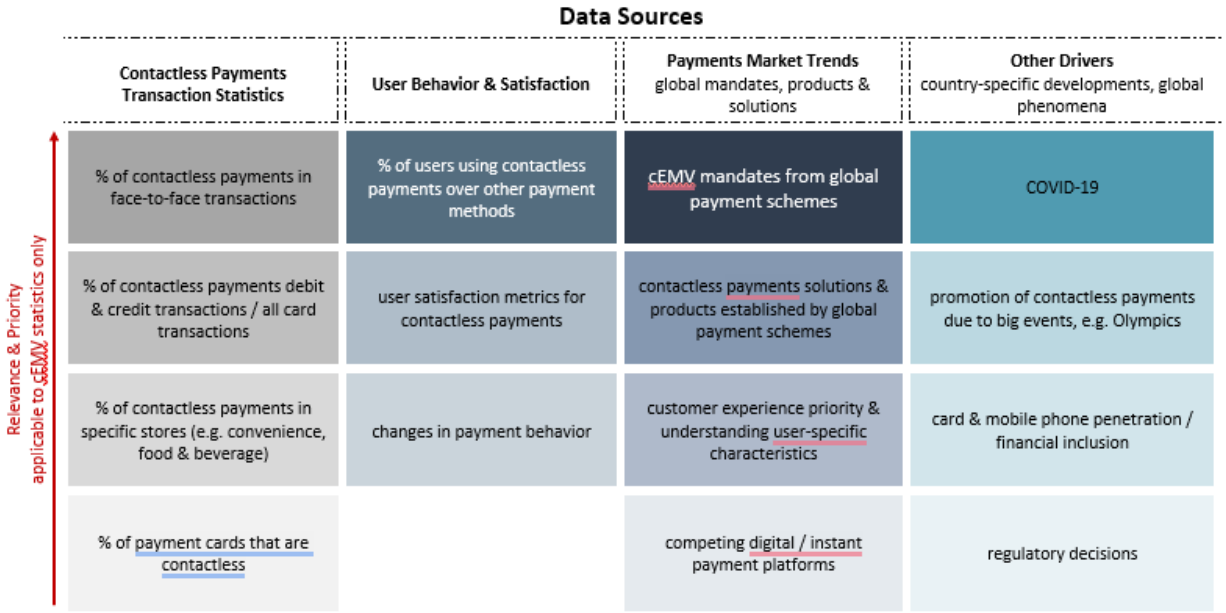
- **Payments market trends**, that pushed contactless payment uptake, and could include the below:
    - Contactless payment mandates from global payment networks
    - Contactless payment solutions and products established by global payment networks
    - Customer experience priority efforts
    - Development of competing digital/instant payment platforms

- **Other drivers** (e.g., country-specific developments, global phenomena) that have impacted contactless payment uptake, and may include the following:
    - Impact of COVID-19
    - Promotion of contactless payment due to high-attendance events, e.g., London 2012 Olympic Games

- Card and mobile phone penetration, or the level of financial inclusion in a given country
- Regulatory changes

The market research conducted for this review was structured using the categories above. The matrix was applied to each of the countries investigated to ensure adequate information was available across the four categories. A visual representation of this data framework and analysis matrix can be found below.

Figure 1: Results using the contactless payments maturity matrix for investigated countries



Research Methodology: Contactless Adoption Maturity

The next step in this research methodology was categorizing the investigated countries based on their contactless payment adoption maturity. The matrix described below is an integrative tool designed to categorize countries based on their development and maturity in the adoption of contactless payment. In the maturity matrix, developments across four categories – contactless transaction statistics, user behavior and satisfaction, payment market trends, and other drivers – contributed to the maturity of contactless adoption in each country as "low," "medium," "high" or "very high." Higher contactless payment usage and more user or market interest in contactless payments, or even digital means of payment, suggest a more mature market in which contactless payment is dominant. To sort the collected data into these maturity categories, we used the following parameters:

- Low maturity: no initiatives aimed at the uptake of contactless payments, with fewer than 30% of transactions utilize contactless technology.

- Medium maturity: some instances of initiatives aimed at the uptake of contactless payments. These efforts are typically isolated and lack coordination with other categories, reflecting a sporadic and unstructured approach. Fewer than 50% of transactions utilize contactless technology.
- High maturity: several instances of initiatives aimed at the uptake of contactless payments. These efforts are typically somewhat coordinated with other categories, reflecting a more structured approach. Between 50% and 70% of transactions utilize contactless technology.
- Very high maturity: numerous instances of initiatives aimed at the uptake of contactless payments, across all categories. These initiatives are frequently motivated by goals set by governmental authorities or market forces, aiming to enhance the adoption of contactless payments. Over 70% of transactions utilize contactless technology.

It's essential to recognize that the matrix is a composite of both quantitative and qualitative assessments, capturing a multifaceted view of the contactless payment landscape and providing a holistic view of the contactless payments' adoption. The coexistence of numerical and experiential information within the same framework may lead to contrasting indications, as a country might score high in quantitative terms but low in qualitative aspects, or vice versa. While all categories in the matrix are equally weighted, the different types of data used may involve interpretations and judgments that could vary among different evaluators. A visual representation of the assessment matrix can be found below.

Figure 2: Results using the contactless payments maturity matrix for investigated countries

Adoption maturity

	Low	**Medium**	**High**	**Very High**
Contactless Payments Transactions Statistic	<30%	30-50%	50-70%	>70%
User Behavior & Satisfaction	no interest / satisfaction in contactless payments	some interest / satisfaction in contactless payments	increasing interest / satisfaction in contactless payments	high interest / satisfaction in contactless payments
Payment Market Trends	no market traction in contactless payments products	some market traction in contactless payments products	increasing market traction in contactless payments products	high market traction in contactless payments products
Other Drivers	no developments aimed at contactless payments uptake	some developments aimed at contactless payments uptake	increasing developments aimed at contactless payments uptake	several developments aimed at contactless payments uptake

Selected countries for analysis

To document the degree of contactless payment uptake globally, this research analyzed data from ten countries located in North America, South America, Europe, Asia, and Australia. The selection of these countries was based on two parameters:

- **Data availability on contactless** payment **uptake and usage**, initially as a portion of the total number of transactions and subsequently in mobility use cases (public transit and gas station payments), and
- **Alignment with the California market**, based on cultural and socioeconomic factors and similarities with the California—or broader U.S.—market.

Our analysis covered many countries worldwide; while the available statistics and information were outdated or insufficient to capture the uptake of contactless payments in a few of our initial research targets, the countries represented in this report provide an adequate mix of information to cover the key categories of our data framework (contactless payment statistics, user behavior metrics, market trends and other drivers). The selected countries are: Australia, Brazil, Canada, Denmark, France, Netherlands, Norway, Singapore, Sweden, and the United Kingdom.

Summary of findings

Our findings indicated that contactless payment has a significant presence in face-to-face and card transactions across the investigated countries. The percentage of contactless transactions in face-to-face transactions ranged from 48% to 94%, while contactless payments accounted for 83% to 89% of card transactions. Contactless payments also dominated transactions in convenience stores, ranging from 52% to 90%. User satisfaction with contactless payments is high, and there is an increasing appetite for more advanced payment methods supporting contactless payments, such as mobile wallets. It's notable to mention that no country in our matrix scored in the low maturity level, further reinforcing contactless payments' position in the global payment market.

Figure 3: Results using the contactless payments maturity matrix for investigated countries

Country	*Contactless payment adoption maturity level*
Australia	Very high
Brazil	Very high
Canada	High
Denmark	Very high
France	Medium
Netherlands	High
Norway	Very high
Singapore	High
Sweden	Very high
United Kingdom	Very high

Moreover, the COVID-19 pandemic has further accelerated the uptake of contactless payments, with a significant increase in contactless transactions observed in multiple countries during the early months of the pandemic, as a result of recommendations aimed at avoiding physical contact. Governments have responded to the demand by raising - and most times doubling - transaction value limits for contactless payments across the investigated countries, making them eligible for an ever-growing portion of the transactions we complete daily.

The impact of other drivers, such as the promotion of contactless payments during events like the London Olympics, has also been evident. In some countries, contactless payments have become the preferred payment method, surpassing other options. It is worth noting that the trends in contactless payment uptake and usage vary across local regions and age groups within each county, with younger generations showing in general a greater affinity for this payment method.

The research findings also underscore the importance of understanding user needs and tailoring interventions accordingly. Governments and key stakeholders should focus on removing barriers to contactless payment uptake, consider the popularity and accessibility of contactless payments, and ensure equity and inclusivity in areas such as electric vehicle charging. By aligning recommendations and emphasizing user-centric approaches, the adoption of contactless payment can continue to grow and meet evolving market demands.

Findings in depth

Contactless payments statistics

In this study, we used two terms to show contactless payment uptake globally. Each of these terms represents a different portion of the market, as noted below:

- Face-to-face (card present) transactions: This category shows the percentage of contactless payments as a portion of all payments that take place when the cardholder and the merchant are physically present at the point of sale. All payment methods (e.g., cash, checks and swipe cards).
- Card (online/card not present and face-to-face/card present) transactions: This category shows the percentage of contactless payments as a portion of all payments that take place using a card (either debit or credit) both at the point of sale and online.

Contactless payment usage among the investigated countries in which data for face-to-face (or else in-person[1]) transactions is available, accounted for **48% to 94%** of the total number of transactions. That means that for the majority of countries, at least half of all transactions were completed using contactless means, whether it was with a physical card, a mobile phone, or a wearable[2].

[1] The definition of "in person transactions" suggests covered transactions that are performed by customers who are physically present at the point of sale.

[2] A type of technology that can be worn on the body, typically in the form of accessories such as wristbands, watches, glasses, clothing, or even jewelry.

Figure 4: Percent of contactless payment transactions out of all face-to-face transactions

Country	*% of contactless payment transactions in face-to-face transactions*	*Source*
Australia	94%	*Reserve Bank of Australia*
Brazil	50%	*Bexs.com*
France	48%	*Ingenico*
Norway	77%	*nfcw.com*
United Kingdom	90%	*Payments Journal*

Among the investigated countries for which contactless payment data as a portion of all card transactions is available, contactless payments accounted for **83% to 89%** of the total number of credit and debit card transactions. That means that most card transactions were completed using contactless means, whether it was with a physical card, mobile phone, or wearable.

Figure 5: Percent of contactless payments in card transactions

Country	*% of contactless payment transactions in card transactions*	*Source*
Denmark	86%	*nfcw.com*
Netherlands	89%	*betaalvereniging*
Sweden	83%	*nets.eu*

Among the investigated countries for which contactless payment data was provided as a portion of the total transactions in convenience stores, contactless payments accounted for **52% to 90%** of the total number transactions. That means that most transactions in convenience stores were completed using contactless means, whether using a physical card, mobile phone, or wearable.

The reason for selecting this data point is multifold: aside from data availability and a large sample size, convenience stores, and retail in general, have been the forefront of new technologies aimed to improve customer experience. Payment behavior in convenience stores also provides a better understanding of customer trends.

Figure 6: Percent of contactless payments in transactions in convenience stores

Country	*% of contactless payment transactions in transactions in convenience stores*	*Source*
Canada	52%	*nfcw.com*
Singapore	54%	*nfcw.com*
Sweden	90%	*Riksbank*

User behavior and satisfaction

Users are becoming increasingly aware and in tune with digital means of payment, which offer convenience and ease. Contactless payments are a central part of this experience and are benefiting from the popularity of digital payments among users. The research further supported this. User satisfaction when using contactless payments is high, contributing to its growing market share. The seamless and convenient nature of contactless transactions has resonated with consumers, offering a frictionless experience at the point of sale. Some of the most interesting findings of this research include:

- In Australia, in-person payments have witnessed a significant shift, with cards now serving as the primary mode of payment, even for small transactions that were traditionally associated with cash usage.
- In Brazil, the high user satisfaction in contactless payments is slowly attracting users who consider it a convenient payment method for road tolls.
- Contactless payments in Denmark achieved a milestone of 3 million users within a span of around one year between 2015 and 2016. In comparison, the adoption of mobile payment and online banking took three and nine years, respectively, to reach a similar user base. *Note: Denmark's population is approximately 5.86 million inhabitants, or approximately one-sixth of California's population.*
- In the United Kingdom, contactless usage has soared, with an impressive 83% of the population embracing this payment method. Remarkably, usage rates remain consistently high across all age groups and regions, with no group falling below 75%.

Payment market trends

The increasing user satisfaction is highly dependent on the emergence of user-friendly products that serve the customer needs. Contactless payment mandates introduced by the global payment networks[3] like Visa and Mastercard have been a driving force for contactless payment uptake. These mandates typically outlined specific requirements or standards to which participants in their networks should adhere. Due to the reach of these networks and the simplification of guidelines, it was made possible for more businesses, small and large, to participate in the contactless payment ecosystem, further enabling merchant adoption while providing interoperability and standardization. The impact of contactless global payment networks is less clear in cases where domestic payment networks hold sway. In such instances, domestic payment networks can either foster user affinity with digital payment methods, and effectively contactless payments (e.g., Denmark), or they can compete with contactless payment technology (e.g., Brazil).

Other drivers

As previously mentioned, the COVID-19 pandemic emerged as a significant catalyst for the increased adoption of contactless payment. In several countries, the percentage of contactless transactions experienced a notable surge, more than doubling in the months following the outbreak, with these figures remaining consistently high since then. Another important factor driving contactless payment uptake is the expansion of transaction limits for contactless payments. By increasing the permissible limit, a broader range of transactions beyond those of smaller value can be captured by contactless payments. Typically, transactions limits are placed for security and risk management reasons. A limit on contactless payments helps mitigate the risk of unauthorized or fraudulent transactions and control their financial impact. During COVID-19, governments focused on responding to market demand, minimizing physical contact, which was deemed necessary to combat the pandemic, but also promoting economic recovery by simplifying payments and thereby stimulating user activity.

- In Brazil, contactless payments surged significantly, experiencing a threefold increase from January to June 2020. Over the course of the entire year, their growth was nearly fivefold. As the adoption uptake of contactless payments continued to expand, there was a notable response to demand in the form of transaction limit adjustments. The transaction limit for contactless payments was raised twice during this period, escalating from 50 to 200 Brazilian real (from approximately 10 to 41 U.S. dollars).

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[3] A global payment network is a system that facilitates the transfer of funds from one financial institution to another, across different countries and often in multiple currencies. These networks enable consumers, businesses, and financial institutions to conduct international transactions seamlessly. They manage and regulate the interchange of transactions between banks, merchants, and consumers globally. Examples of global payment networks include Visa, MasterCard, and American Express. Source: *Investopedia*

- In Canada, the usage of contactless transactions using credit and debit cards showed robust year-over-year growth of 32% by the third quarter of 2020. By the close of the year, contactless payments took up a substantial share, approximately 60%, of the total transactions. This growth was supported by the decision to enhance the usability of contactless payments through a tap limit increase from 100 to 250 Canadian dollars (from approximately 74 to 185 U.S. dollars).
- Similar responsive measures were undertaken in the United Kingdom, Sweden, and Norway. These countries adjusted their payment landscape in light of the escalated demand for contactless payments during and following the COVID-19 pandemic.

The impact of other drivers, such as the promotion of contactless payments during high-attendance events like the Olympic Games and the increase of contactless due to the boom of other payment means, is also evident:

- The use of contactless payments at the 2012 London Olympics provided valuable insights to major retailers and transport authorities regarding its efficiency in high-density areas. As a result, major fast-food chains and grocery stores began accepting contactless payments.
- In Australia, the increase in contactless payments since 2019 was driven by a significant increase in the use of mobile devices such as phones, watches, and rings, to account for 30% of all in-person card payments.

Some of the countries investigated (specifically in the Nordic region[4]) are on track to become completely cashless in the coming years. As a result, they have focused on ensuring access to traditional financial products for all residents. These efforts have further supported contactless payment uptake, making users more familiar with this payment method.

Contactless payments in mobility

To better understand the mobility landscape and any potential user influences on the payment market for mobility, we ran a parallel analysis on contactless payment uptake in public transport, for which data was readily available across a considerable number of countries. The key insight of our research was that it took contactless transactions approximately 2 years since initially introduced across public transit modes, to reach one-third of the total number of transactions. Uptake after that point was rather quick for most cases, but dependent on local market and user characteristics.

[4] The Nordic countries (else Nordics) are Denmark, Norway, Sweden and Finland.

Figure 7: Overview of contactless payment uptake in major transit agencies in the countries analyzed

Region	*contactless payment as a % all transactions*	*Date introduced across all modes*	*Time taken to reach one-third of transactions on contactless if data is available*
Transport for New South *Wales, Sydney - Australia*	~30%	September 2020	1 year September 2021
Land Transport Authority*, Singapore*	~30%	April 2019	
Translink, *Netherlands*	~15% (where launched[5])	April 2023	
Transport for London*,* *London - United Kingdom*	~65%	September 2014	2 years Mid 2016
Translink*,* *Vancouver - Canada*	~2%	May 2018	
Metropolitan Transportation Authority*, New York City - United States*	~40%	December 2020	2 years April 2022
Monterey-Salinas Transit*, California - United States*	~6%	May 2021	
Clean Air Express*,* *California – United States*	12%	July 2021	

Defining a threshold of contactless payment dominance in the payments market

Based on the research findings, it is challenging to establish a specific threshold at which contactless-only payment doesn't present a barrier for users participating in payments for electric vehicle charging and more. That is because the uptake significantly varies across countries and industries and depends on technological advancements, user preferences

[5] The OVpay is a nationwide central system in The Netherlands. Launch took place in stages across different cities in the country.

and regulatory initiatives. Based on the observed trends on the countries documented, there are some general recommendations on defining a threshold.

1. **Market share and penetration:** This refers to the percentage of contactless transactions in face-to-face or card transactions. In face-to-face transactions, when contactless payment accounts for a substantial portion, such as 50% or more, it can be indicative of significant adoption and usage. For card transactions in general, when contactless payments represent a significant majority (around 70% or more) of card transactions, it suggests a shift toward contactless payments.
2. **Industry-specific insights:** This refers to the percentage of contactless transactions in specific sectors, such as convenience stores or mobility (e.g., gas stations). When contactless payments dominate these industries, exceeding 70% of transactions, it demonstrates a substantial presence.
3. **User behavior:** This refers to user behavior and satisfaction metrics. When most users prefer and actively use contactless payment over other payment methods, it indicates a significant acceptance and adoption rate.

It's important to note that these thresholds are general guidelines and should be considered in conjunction with other factors, such as regional and demographic variations. Once markets reach a certain level of maturity, the emphasis should transition from research and understanding to action and implementation. Consequently, the focus should shift toward removing barriers that might hinder users from fully embracing and using contactless payment technology, to the extent where it remains a technology preferred by customers and helps expand the zero-emission vehicle market.

When evaluating the adoption of contactless cards in countries like the United States (such as Canada, Australia, UK, etc.), studies have revealed that they are predominantly used in merchant categories that experience frequent, low-value transactions. Specifically, these categories include convenience (food and grocery) stores, quick-service restaurants, restaurants, and drug stores/pharmacies. With these categories collectively representing 60% of cash transactions in the U.S., the widespread usage of contactless cards in these establishments presents a favorable opportunity to encourage consumers to transition from cash to card payments.

CONCLUSIONS & RECOMMENDATIONS

Lessons learned from the experience of countries internationally on contactless payments, and insights on market trends and user appetite, can help set up solutions for electric vehicles and electric vehicle charging that maximize accessibility and usability. This report's key findings and recommendations are summarized below.

Key finding 1: Globally, contactless payments are becoming the standard method of payment.

Contactless payments in face-to-face transactions fluctuated between 48% to 94% of the total number of transactions, while almost eight out of nine card transactions were executed using contactless means.

Further evidence supported an increasing user appetite and demand for contactless payments across age groups.

Key finding 2: When the large majority of transactions are contactless, contactless-only doesn't become a barrier for user participation.

Defining a threshold at which contactless-only payment doesn't become a barrier for users depends on several indicators. Based on international examples, a significant shift to contactless payments can be identified when the following criteria are met:

- Over 50% of face-to-face transactions are contactless,
- Over 70% of all card transactions are contactless,
- Over 70% of transactions are contactless in high-traffic locations like convenience stores.

Key finding 3: Relying on market trends isn't sufficient to drive change; the government's role in establishing a payment method with the general public is pivotal.

Some events (COVID-19) seem to have been critical for the uptake of contactless payments.

As a response to the increased demand, governments have changed -- and, on many occasions, more than doubled -- the transaction limit for contactless payments, expanding the scope of transactions that can be conducted via contactless methods beyond those of smaller value, meeting consumer demand.

Recommendation 1: The optimal equity outcome is the one that entails fewer barriers for lower-income and un/underbanked communities. Contactless payment seems to be meeting these needs. As such, regulatory bodies in California can create continuity on Senate Bill (SB) 123 regulation around the use of contactless payment for electric vehicle charging at a station.

With contactless payment being a preferred payment method across users internationally, there is growing necessity in ensuring that low-income communities are not left behind in this digital transformation. Embracing contactless payments can, therefore, be a significant step toward reducing financial disparities and creating a more equitable financial landscape, that eliminates barriers for all.

As SB 123 has been signed into law, we recommend the regulatory bodies in California, such as the California Energy Commission maintain the current guidance on the use of contactless payment as one of the main payment methods for electric vehicle charging.

Recommendation 2: State and local agencies need to facilitate financial access to those without it.

Evidence from our research shows that, to date, the contactless payment uptake that took place during the pandemic is still going strong. A large part of this can be contributed to government intervention, which has further bolstered the continued trend toward contactless payments.

As contactless payments continue to grow, government intervention and continued efforts to ensure access to financial products for all are pivotal for equitable payments solutions.

Next steps

Up to this stage, the choices made regarding payment options for electric vehicle charging have been aligned with the requirements and current state of the Californian market. As contactless payment continues to grow, the State and other stakeholders have an opportunity to use market trends to ensure equitable payment solutions for all. There is now, more than ever, is the time for the State to stimulate inter-agency collaboration on electric vehicle charging and bring together participants across State agencies that are working on similar matters. Combining the experience of international peers with local needs can help promote electric vehicles and electric vehicle charging.

Appendix A – Table of abbreviations

Figure 8: Table of abbreviations

Abbreviation	*Meaning*
ATM	Automated Teller Machines
cEMV	Contactless EMV
EMV	Europay, Mastercard, Visa
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
NFC	Near-field communications
PIN	Personal Identification Number

Appendix B – Sources

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Appendix C – Version control

Figure 9: Version control table

Status	Version	Author	Date	Changes
Draft	v0.1	Rebel	07/17/2023	First draft
Draft	v0.2	CARB	07/31/2023	First round of comments & review from CARB team
Draft	v0.3	Rebel	08/09/2023	Comments resolved from Rebel team, changes in document based on CARB team recommendations
Draft	v0.4	CARB	08/22/2023	Second round of comments & review from CARB team
Draft	v0.5	Rebel	08/30/2023	Comments resolved from Rebel team, changes in document based on CARB team recommendations
Draft	v0.6	Rebel	06/07/2024	Updated broken link and adjusted subtitle hierarchy