EV charging payments

Payment innovation drives user experience
and accessibility in EV charging

Key takeaways

→ Public EV charging is poised for exponential growth

→ Today's public charging experience is suboptimal

→ EV drivers and regulators push for card payments

→ First movers show benefits of card payments

→ Innovation will further improve charging experience

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Introduction

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EVs will take over the streets of Europe in the next decade in an effort to curb climate change. With that, the need for accessible and convenient charging infrastructure accelerates - be it at home, on the street, at destinations like shops or work or on-the-go at high traffic (highway) locations. Electrification of individual transport requires dense, accessible charging infrastructure.

EV drivers recognize that accessibility is a top pain point of today's charging infrastructure due to the lack of interoperability between different EV charging cards and charging networks. As a driver, you are often unsure if you can actually charge at the charge point of your choice, as it is unknown if you have the right payment method. Lack of standardisation and competition have led to a fragmented market, increasing range anxiety of EV drivers.

To enable the electrification journey of European road transport, EV charging payment needs to be solved. Mastercard, as a global technology company aimed at empowering the digital, inclusive economy by making transactions safe, simple, smart and accessible, has a strong and broad set of capabilities to make EV charging payments work. PaymentGenes, a dedicated payments consultancy firm with mobility as one of its core pillars, has the complementary capabilities to support clients in shaping the solutions that support their needs. Thus, we are collaboratively driving Europe's journey towards a carbon-neutral economy.

This white paper aims to uncover the potential to improve EV charging infrastructure accessibility and user experience by solving EV charging payments. The EV charging payments space is too broad to provide a simple recipe for the best payment solution for all use cases. Rather, this white paper is intended to create the baseline understanding of possibilities from which tailored solutions can be shaped. Mastercard and PaymentGenes invite readers – be it from drivers' associations, eMSPs, CPOs, charge point manufacturers or others – to reach out to start the conversation on EV charging payment. Together, we can realize Europe's electrification journey and provide drivers with their preferred choice of payment methods.

01

Public EV charging is poised for exponential growth
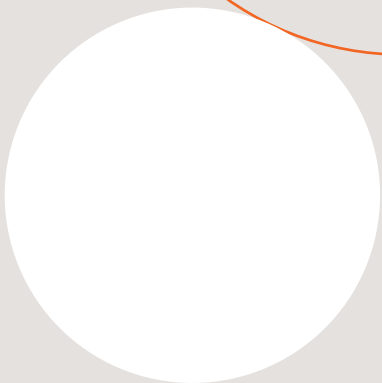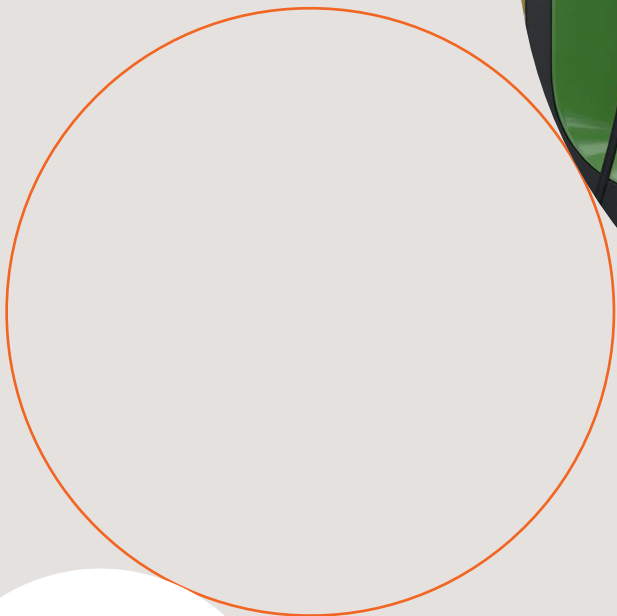
6m

electric passenger cars in
Europe in 2022

Europe's electrification of passenger cars has taken off

The electric car is a European invention. The first electric car was built almost 140 years ago, in 1884.[1] It was built by an Englishman, Thomas Parker, and drove in the streets of London. Although there was initial interest, some historians estimate that about a third of the cars in the U.S. were electric around

1900 – it took another 120 years before the electric car definitively took off.

Today, Europe's electric passenger car fleet, including both Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) almost counts 6 million vehicles.[2] With a very strong growth rate of about 75% per year over the past three years, the electric passenger car fleet is accelerating.

Electric vehicles require charging stations at regular intervals to enable a smooth driving experience. Most charging stations in Europe are private, often installed at a private driveway. There are also almost 500 thousand public chargers in Europe.[3]

Most of these (88%) are AC chargers compared to 12% DC chargers.

ACEA, the industry body for car manufacturers in Europe, has forecasted that the total amount of public chargers will grow to 3.9 million in 2030, based on proposed regulation.[5] The number of public chargers will need to grow in line with the growth of EV vehicles. Additionally, it is expected that the share of public charging in overall charging will also grow over time as more accessibly priced EV models enter the market. The share of EV drivers that has access to a private driveway for home charging will decrease as a consequence.

Number of electric passenger cars in EU [2,4]
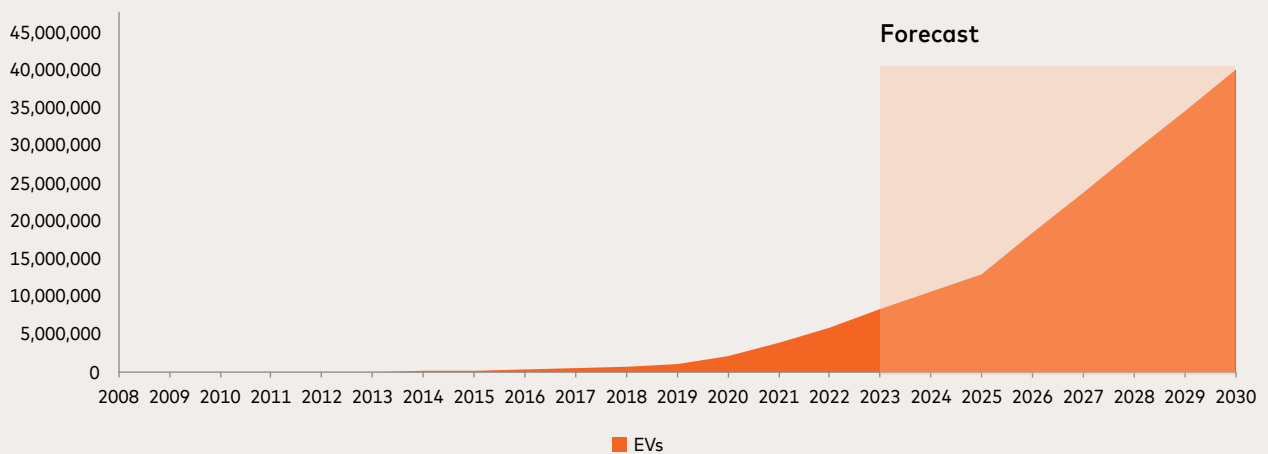
Number of public EV chargers in Europe including forecast [6,7]
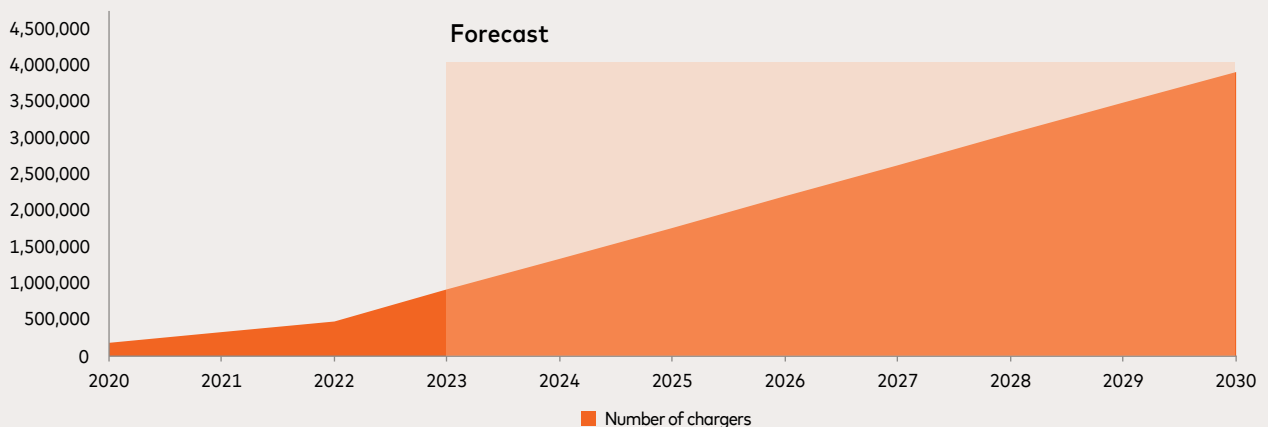
48m

electric passenger cars in
Europe in 2030

Proposed AFIR regulation sets targets for EV growth

In 2021, the European Commission laid down the proposal for the Alternative Fuel Infrastructure Regulation (AFIR) as part of the European Green Deal. Part of the proposed regulation are strong targets on the growth of EVs and public EV charge points towards 2030, far beyond what is currently forecasted by the industry:

- **48 million** electric vehicles (including both BEVs & PHEVs)
- **3.9 million** public chargers
- **40% of charging** expected to take place at public charge points[8]

In a response to this proposal, the European Automobile Manufacturers' Association (ACEA), an association representing Europe's 14 major car, truck, van and bus manufacturers, has proposed stretched targets of 7 million public chargers at an expected 60% of charging occurring at public charging stations.[8]

AFIR: European Commission, European Parliament and European Council positions

The AFIR regulation is currently in the legislative process. In 2021, the European Commission published the initial AFIR proposal covering alternative fuel infrastructure. With respect to payments, the AFIR proposes to require (open-loop) card payments on DC chargers, starting with new chargers as soon as the regulation is in effect and retrofitting the installed base by 2027. In 2022, both the European Parliament and the European Council have responded to the proposal. Whereas the European Council supports the current proposal, the Parliament proposes to further extend the requirements for card-payment acceptance. Trilogues are currently in process and expect to conclude in the second quarter of 2023.

Electric passenger cars as percentage of new passenger car registrations [9,10]
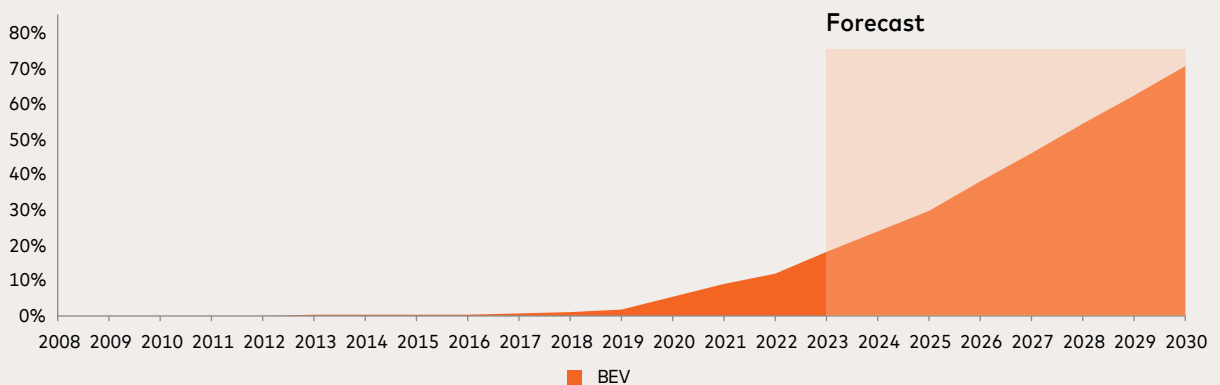
02

Today's public charging experience is suboptimal
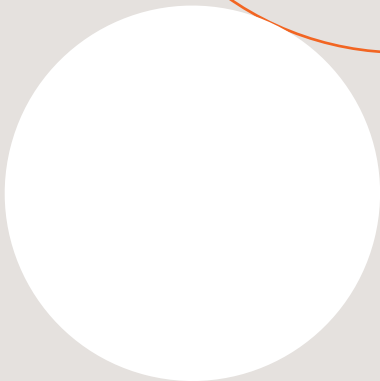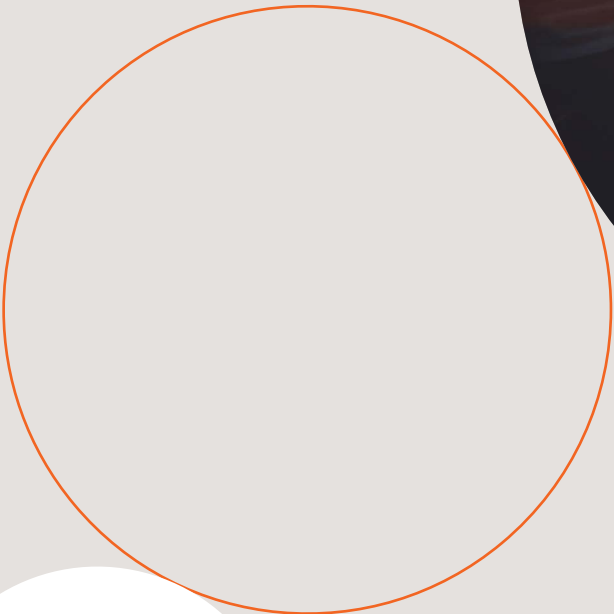
80%

of charging units are
private residential

EV charging occurs at varying locations and conditions

EVs can be charged at different locations – at your private driveway, on the street near your house, at destinations like shopping malls, hotels or your work location and during a trip at a charging station next to the highway. Generally speaking, a distinction is made between private, semi-private and public charge points. Most charge points are private (80%), followed by semi-public (11%) and public (9%).[11] However, as public chargers typically have a higher power output and usage frequency, a substantially higher share of total power distribution for EV charging flows through public charge points. For example, where AC chargers, charge on average 5.9 kWh per day, fast DC chargers (101-250 kW) charge a more than tenfold higher average of 77.7 kWh per day.[11]

In addition to different locations, charging experiences differ depending on the relationship between the driver and the operator of the charge point. In case of private charging, the charge point is owned by the driver so no transaction takes place between driver and charge point. For semi-public and public charging, there are essentially two models. Either the driver has a subscription through a e-Mobility Service Provider (eMSP) that is connected with the CPO, or the driver does not have a subscription and is 'unknown' to the CPO. In case of a subscription, the drivers only need to identify themselves as a known driver through tapping a RFID card or token or in-app identification and the costs of the charging session are added to the drivers' bill and typically invoiced to the driver (at the end of the month).
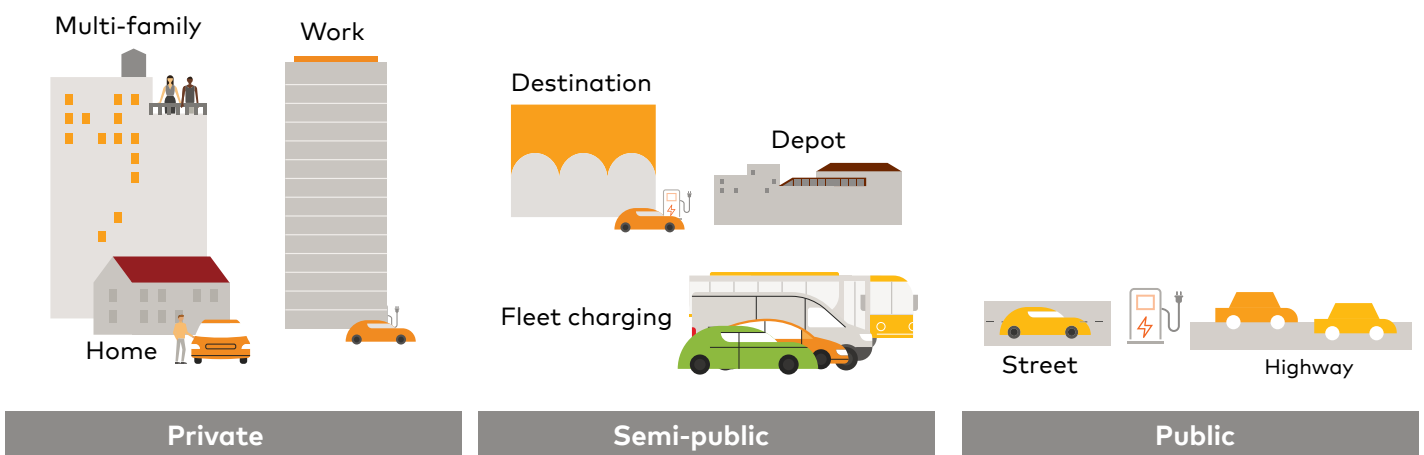

Figure 1: Overview of charging locations, adapted from ChargeUp Europe (1)

In this whitepaper we refer to card-based payments when a credit card, debit card or (card-based) mobile wallet is used to perform an NFC-based transaction with the POS terminal on the charger. If the driver chooses to start an ad hoc charging session, an ad-hoc (or direct) payment takes place, either through tapping a credit card, debit card or mobile wallet to the point-of-sale (POS) terminal or performing an in-app or online payment (often initiated through a QR-code presented on the charger).

Comparison of payment methods for EV charging at (semi-) public charge points

	Ad-hoc		Contracted
Payment method	**Payment card** (including card-based wallets)	**Online** (In-app or QR-code)	**Subscription** (roaming or app)
Point of interaction	• NFC contactless • NFC contactless and PIN • Chip & PIN	• No physical interaction	• RFID card or token • No physical interaction in case of in-app
Payment rails	• Cards	• Cards • Instant payments (account-to-account)	Invoice followed by: • Cards (Card-on-file) • SEPA Direct Debit
Timing of payment	• Cards	• Direct	• Pre-paid or • End of month
Open- or Closed-loop	• Open	• Open	• Closed
Primary target audience	• Consumer	• Consumer	• Business

Note: Overview describes typical state of affairs and is non-exhaustive

4+

different cards for EV charging are held by 36% of the drivers

Drivers encounter complicated payments experience

As a consequence of the different types of charging and subscription models, the EV charging landscape has become very fragmented. Depending on the country you are in and local legislation and standards, you may or may not be able to charge at the next public charging station on your route. Typically depending on the type of MSP subscription(s) you hold and whether or not the charging station accepts ad-hoc payments.

As a consequence of this fragmentation, 36% of the drivers own four or more different cards and/or tokens to charge at different charging networks.[12] The same research showed that drivers in various European countries use on average more than three different apps related to EV charging.

This results in a cumbersome payments experience. For example, consumer research in Norway showed that 90% of EV drivers considered it to be a complicated experience, navigating multiple charging apps, cards and operators.[13]

Average number of EV related apps used by drivers [12]
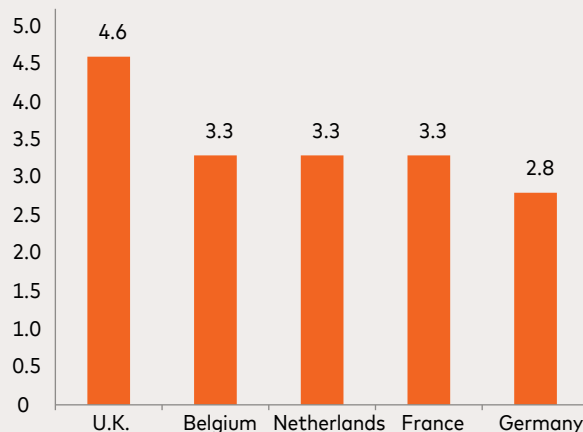
Number of charge cards owned (percentage of respondents) [12]
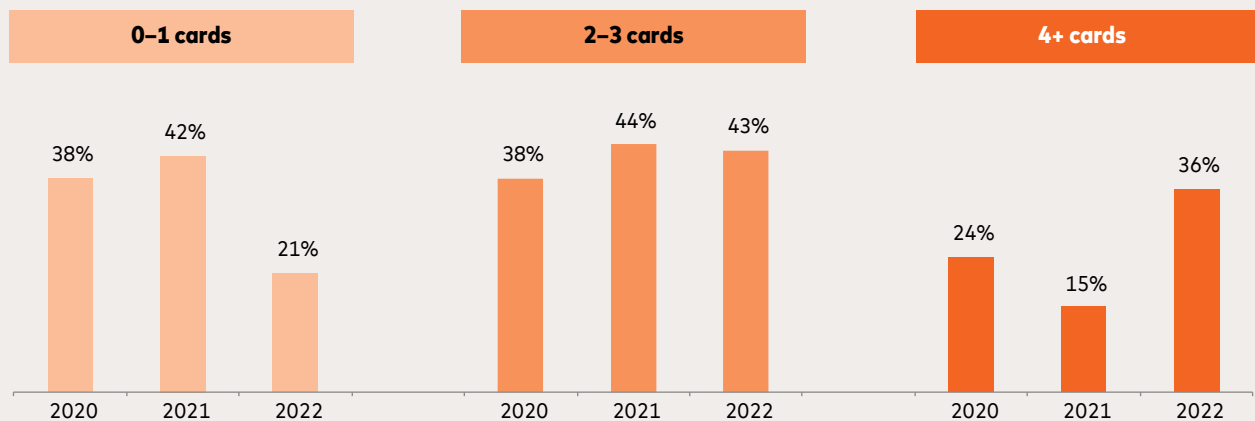
03

EV drivers and regulators push for card payments

65%

of consumers prefers to pay for EV charging with a debit or credit card

EV drivers prefer to pay for charging with debit or credit cards

When asked, drivers indicate that they would prefer to pay for EV charging leveraging the payment methods they are used to for other everyday point-of-sale transactions. The majority, 65% of consumers, prefers to pay for EV charging with a debit or credit card at the point-of-sale, followed by cash (33%) and mobile wallets (13%).[14]

The consumer preference to leverage their payment card for EV charging payments is confirmed in multiple consumer studies. For example, a Shell Recharge study showed that in terms of EV charging payment innovation, consumers would prefer to pay by (debit or credit) card or Plug & Charge (both 31%; see Chapter 5 for more information on Plug & Charge) followed by contactless payment by mobile phone (24%).[15] Additionally, the preference for card payments is increasingly acknowledged by regulators (among others, the European Commission and Norwegian and U.K. governments). Essentially, card payments enable CPOs to tap into a customer base of about 810 million payment cards currently in circulation in Europe.[16]

Preferred payment methods for EV charging (percentage of respondents)[14]

Payment method	Percentage
Physical debit or credit card	65%
Cash	33%
Mobile wallet	13%
Fuel cards	11%
QR code	10%
Subscription	10%
Merchant app or website	9%
Other	6%
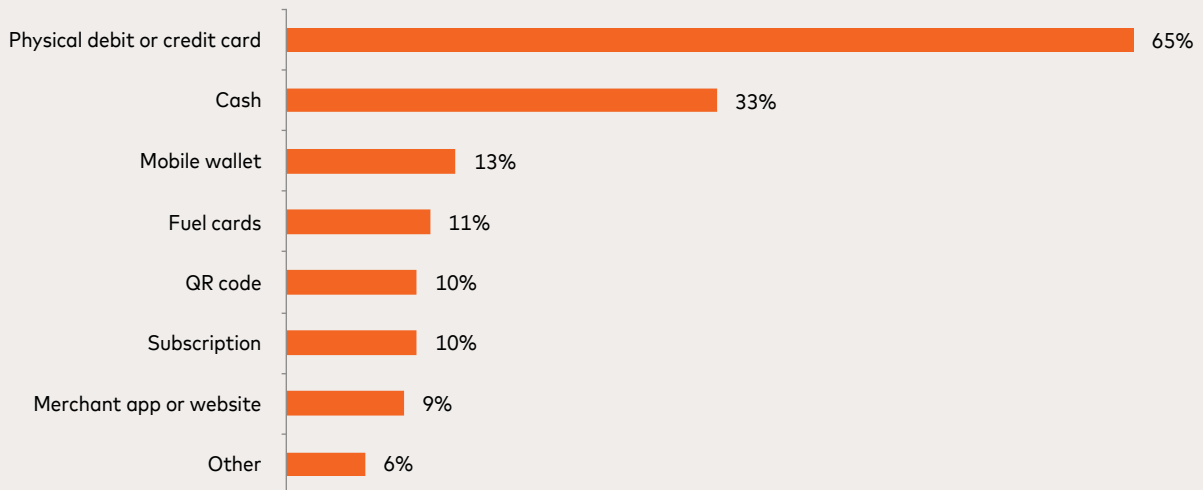
15.867

fast chargers in Germany will have to be able to accept card payments by July 2024

Regulators move to enforce card payments on public chargers, starting with Germany in July 2024

Coming from an overall ambition of making the European Union the first carbon-neutral continent, for which the strategy is detailed in the European Green Deal, regulators are heavily engaged in the electrification of transport and, in particular, passenger vehicles. To reach net-zero carbon emission, passenger vehicles need to be electrified and the infrastructure needs to be in place to facilitate a smooth driver experience. As part of this ambition, regulators aim to remove any barriers to the adoption of EVs and improve overall accessibility of charging infrastructure. Requiring the availability of card payments on EV chargers is often a part of this. Whereas in many countries, regulation is in various stages of approval, the German regulation (Ladesäulenverordnung or LSV) is currently being implemented; as of July 2024, all new chargers are required to accept card payments.

Jurisdiction	Status	Scope of regulation			
		New chargers		Installed base	
		Slow	Fast (>50kW)	Slow	Fast (>50kW)
EU (AFIR)	Proposal	Upon approval	Upon approval	2027	2027
Germany	Regulation	2024*	2024	2024*/**	2024**
Denmark	Regulation		2022		2026
Sweden	Industry Agreement	2022	2022	2022	2022
U.K.	Proposal	2023	2023	-	2024
Norway	Proposal	-	2023	-	2025
Finland	Market consultation	Outcomes of market consultation not yet known			
Spain	Regulation	Obligation to offer payment option without contract			

Requirement to enable open-loop payments through cards or digital/in-app

Requirement to enable card payments with some exemptions

Requirement to enable card payments

Sources:
- Norwegian EV Association
- EV Charging Payments Digital Summit (January 26 2023)
- Swedish Energy Agency | Accelerated electrification of road transportation and uniform payment solutions in the Nordic countries
- electrive.com
- energiforetagen.se
- RVO, German Charging Infrastructure Regulations; Supporting Dutch companies understanding the German framework (2019)

* Charging stations with a charging capacity < 3.7 kW are excluded
** Charging stations installed before December 14, 2017 are excluded

Various CPOs have moved ahead of regulation and enabled card-based payments

2018

Allego launches contactless debit and credit card payments for EV charging

2021

Fastned
8 March 2021

We've made it easy to pay ad hoc without registration 👆
In the Netherlands, Belgium, Germany and Switzerland you can now pay with your debit or credit card by simply scanning the QR code presented on the charger screen.
#emobilität #EVcharging #elektromobilität

2022

Nov 24, 2022 - 04:21 pm

Recharge to enable card payments for Nordic charging

AC | CARD PAYMENTS | CHARGING STATIONS | DC | DENMARK | FINLAND | HPC | NORDICS | NORWAY | RECHARGE | SWEDEN

In the Nordics, Recharge will be the first major operator to integrate card payment terminals at its charging stations. The launch will take place in Norway in 2023. The Norwegian parliament is also currently debating the introduction of corresponding legislation with this stipulation.

Recharge says it operates the largest charging network in the Nordics, with more than 2,500 charging points in Norway and another 1,500 in Sweden and Finland. The company, which is owned by British infrastructure investor Infracapital, will initially install new charging stations in Norway with card terminals. The terminals will be introduced into the existing charging network as soon as the older charging stations are replaced or upgraded.

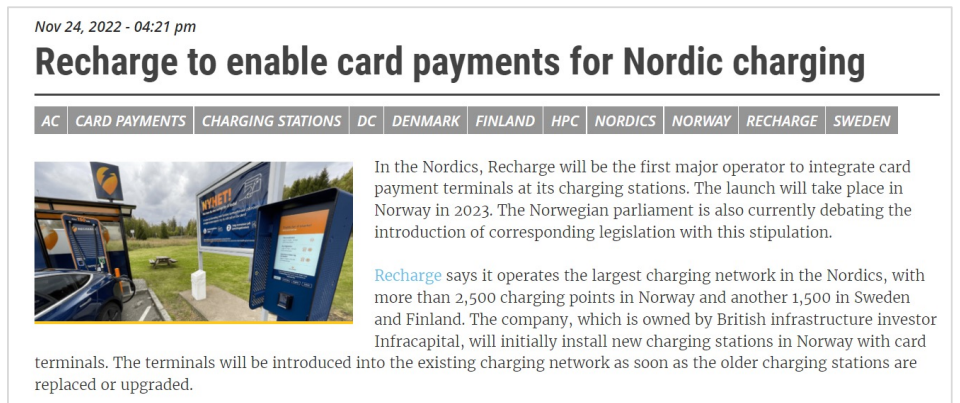## Baseline scenario of at least 1.3 million card-based payments enabled chargers in 2030; increasing to 3 million if consumer demands is met

Both EU and national regulatory proposals lay down ambitions in terms of number of (AC and DC) chargers and enablement of card-based payments towards 2023 (with often varying requirements for AC versus DC chargers and new chargers versus the installed base). Based on these proposals, a base-line forecast of the minimum number of chargers that are enabled to accept card-based payments can be developed.
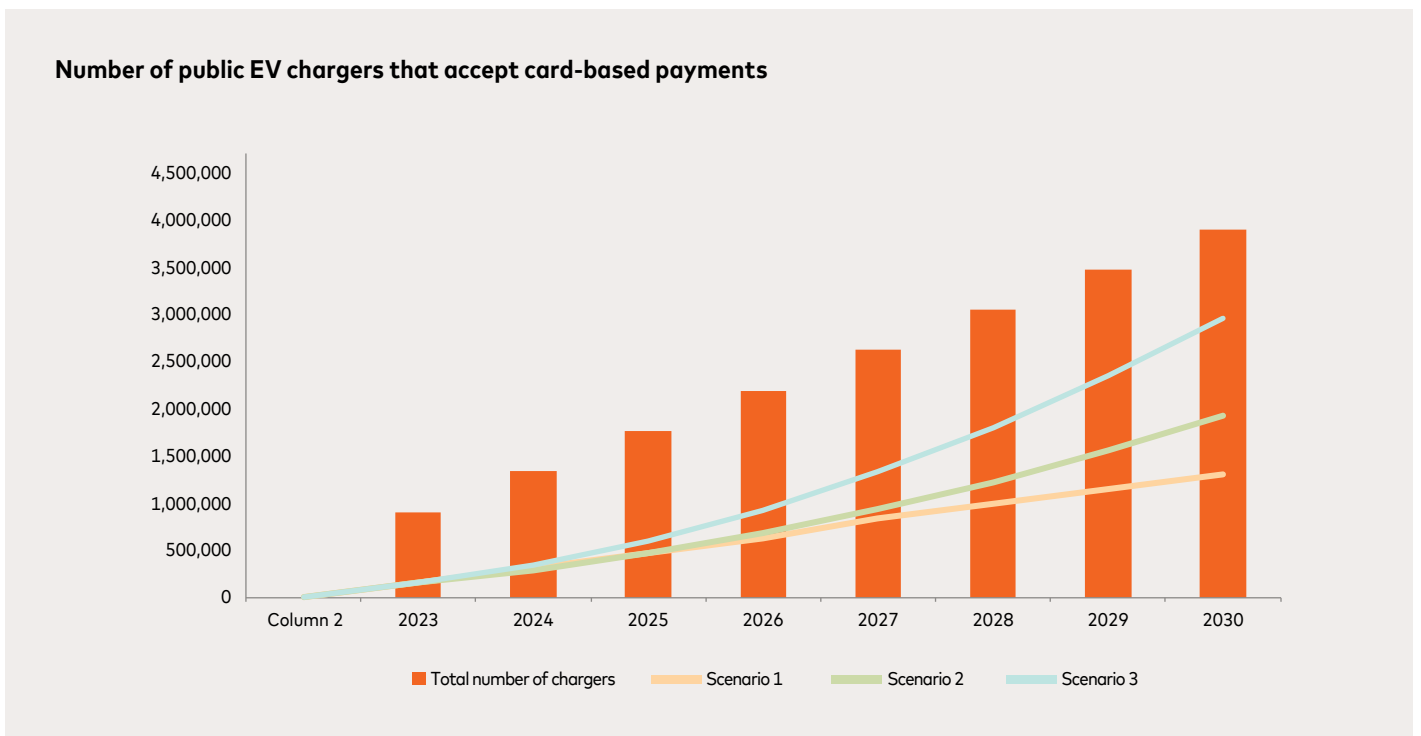
Number of public EV chargers that accept card-based payments

As identified earlier, beyond regulation there is substantial consumer demand for the enablement of card-based payments. Hence, the following scenarios have been identified.

Scenarios	Scenario 1: Baseline	Scenario 2: Intermediate	Scenario 3: Consumer-driven
Explanation	Card-based payments will be enabled on all DC chargers, in line with AFIR proposal	Card-based payments will be enabled on all DC chargers and one-third of the medium to faster (11+ kW) AC chargers, that enable a full charge in a few hours and thus have relevance for destination charging	Card-based payments will be enabled on 65% of all AC chargers, in line with overall consumer preference share of card-based payments (65%)
Enablement of slow AC* (~25% of all public AC chargers)***	0%	0%	65%
Enablement of medium to fast AC* (~75% of all public AC chargers)***	0%	33%	65%
Enablement of DC* (33% of all public chargers)**	100%	100%	100%
% of total chargers enabled*	33%	~50%	~75%

* All % are 2030 forecasts

** Source: ChargeUp Europe

*** Source: Transport & Environment; Recharge EU: How many charge points will Europe and its members states need in the 2020's

The modelling is based on the following generic parameters:

- Target (2030) total number of chargers and enablement of card-based payments according to AFIR proposal from European Commission, as interpreted by ACEA[17]
- Split of charger types according to Transport & Environment forecast[18]

On top of European legislation, national regulators move ahead and lay down ambitions and requirements, sometimes beyond what is being proposed on European level. Germany, in particular, has an ambitious target to realize 10 million public charge points by 2030 and requires card acceptance on chargers in the Ladesäulenverordnung.[19]

Total power distributed through card-based payment enabled chargers reaches 72% total public charging power (kWh)

DC chargers have a much larger share in power output than a simple charger-count would suggest. Hence, the total power distributed through card-based payment enabled chargers, which are more often DC chargers, will also be relatively high. Remember that today AC chargers, charge on average 5.9 kWh per day whereas the fast DC chargers (101-250 kW) charge a more than tenfold higher average of 77.7 kWh per day. A simple modelling, building on the AFIR targets represented in Scenario 1 on the previous page and presuming a modest daily power output of 5.9 kWh for AC and 30.5 kWh for DC chargers, yields the following results.[20]
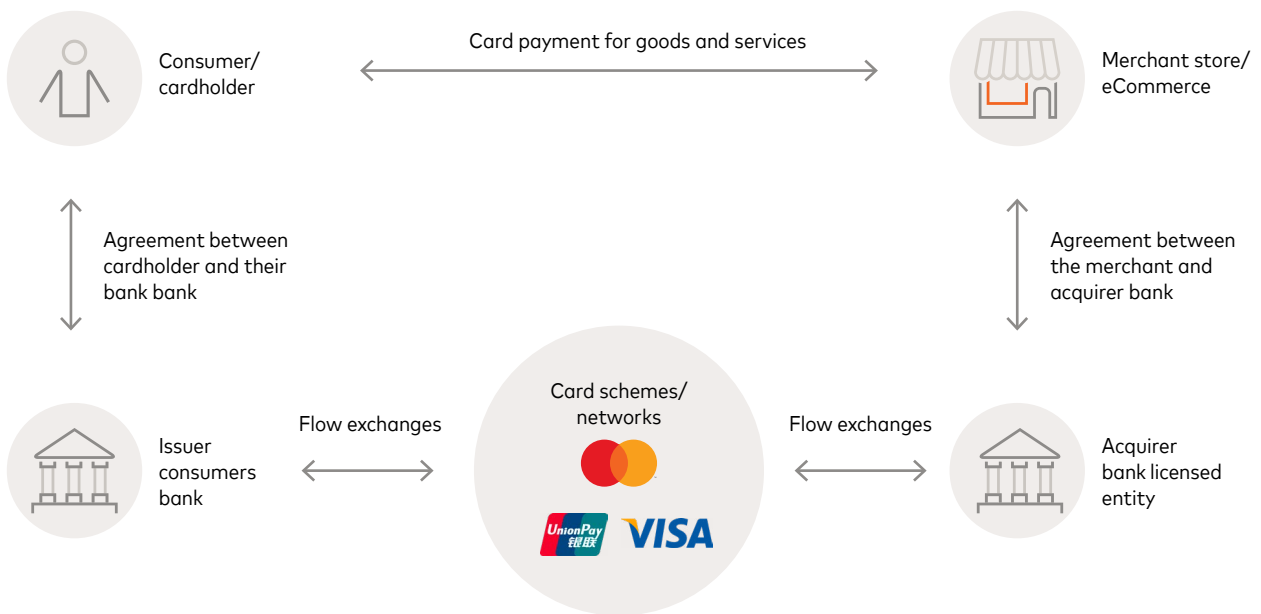
Percentage of kWh distribution through chargers that are card-based payments enabled in Scenario 1
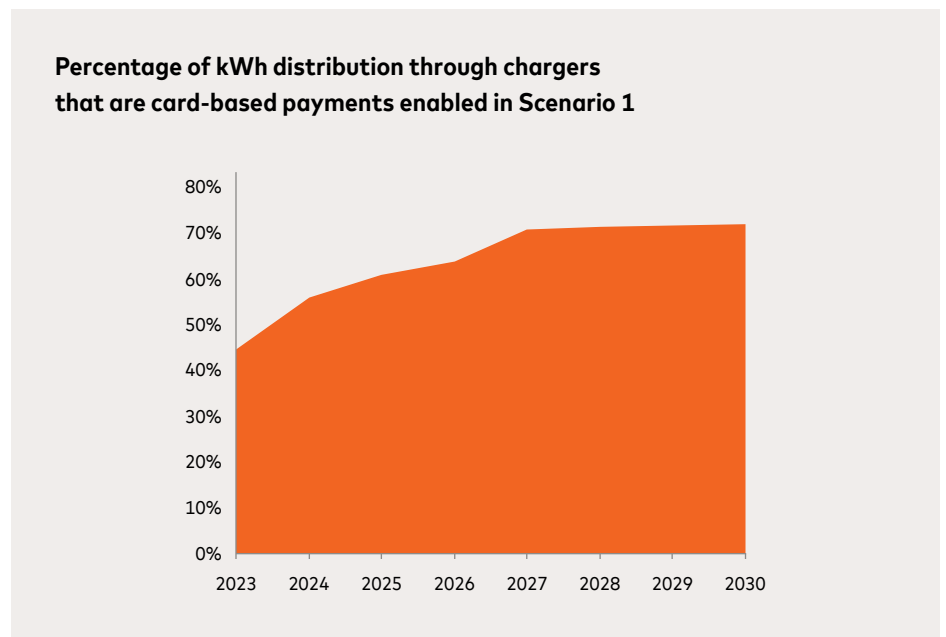
04

Card-based payment solutions for EV charging

How do card-based payments work?

Card-based point-of-sale (POS) payments refer to the use of regular debit or credit cards to pay at a POS device. Card-based payments typically rely on the four-party model (see image below) where a transaction touches the four corners (merchant, acquirer, issuer and cardholder). A transaction is initiated when the card is tapped against the card reader (or inserted to read the chip). Presuming the former, the card is read by the card-reader (depending on the contactless limit a PIN entry may be required) and passed on in the payments processing value chain to the acquiring processor, payment network and issuing bank to validate if the card is valid and has sufficient spending limit. If the transaction is authorised by the issuing bank, an approval message is sent bank along the processing chain to the terminal to display the message that the transaction is approved.

Consumer/
cardholder

Card payment for goods and services

Merchant store/
eCommerce

Agreement between
cardholder and their
bank bank

Agreement between
the merchant and
acquirer bank

Issuer
consumers
bank

Flow exchanges

Card schemes/
networks

Flow exchanges

Acquirer
bank licensed
entity

Key requirements for card-based payments

Card-based payments have been continually developed and improved over more than half a century to ensure convenience, interoperability, safety and security. Hence, robust and proven international frameworks are in place that need to be adhered to when accepting card-based payments from international card brands like Mastercard or Visa. Key frameworks include PSD2, EMVCo and PCI.

The Payment Services Directive 2 (PSD2) is the EU regulation on payments. It contains various rules and regulations that aim to ensure safe, secure, convenient and fairly priced payments in Europe. One of the cornerstones of PSD2 is Strong Customer Authentication (SCA) which regulates what authentication measures need to be in place to ensure safety of transactions (See "Card-based payments dictionary").

EMVCo is the industry body of six global card schemes (Mastercard, Visa, American Express, Discover, JCB and Union Pay) that develops the technical baseline in terms of specifications on how card payments work. Standards for contact chips, contactless, mobile payments, tokenisation and QR codes are all developed by EMVCo. This provides the baseline to work from for both terminal and payment card manufacturers.

PCI Security Standards Council is a standard setting body for the payments industry. PCI develops security standards for POS devices, 3DS, point-to-point encryption solutions and SoftPOS solutions. Payment solutions need to be certified against these standards by an accredited security evaluation organisation (called a security lab) before they can be deployed. For example, terminal safety and security requirements are set by PCI. All these measures are in play to assure the safety and security of transactions.

As a CPO, like any other merchant for that matter, PSD2, EMVCo and PCI Security Standards should be taken into account by your payment provider. Typically, a merchant does not have to address those complexities. However, in order to assess what is and what isn't possible with card-based payments it is valuable to develop a basic understanding of these concepts.

How do card-based payments for EV charging work?

For EV charging payments, there are a few particularities in place. First, because the payment terminals need to be robust and are unattended (increasing risk of damage), they are typically contactless with PIN-pad, without the option to insert the card (except in offline PIN markets). Second, pre-authorisation is used as the transaction amount is unknown at the start of the charging session. A pre-authorisation for an estimated amount takes place to reserve an amount on the cardholders account for the charging transaction. After the charging session is finished, the final amount (based on actual kWh charged) is again processed and the final amount is charged to the underlying card account. Finally, in EV charging payments the option to enable incremental authorisations exist. In case the actual amount is higher than the pre-auth amount, the incremental amount is again processed through the payments network. However, as the incremental at the end of the charging session may trigger a PIN entry, it is considered a best practice to set pre-auth amounts sufficiently high to prevent incremental and potential customer friction.
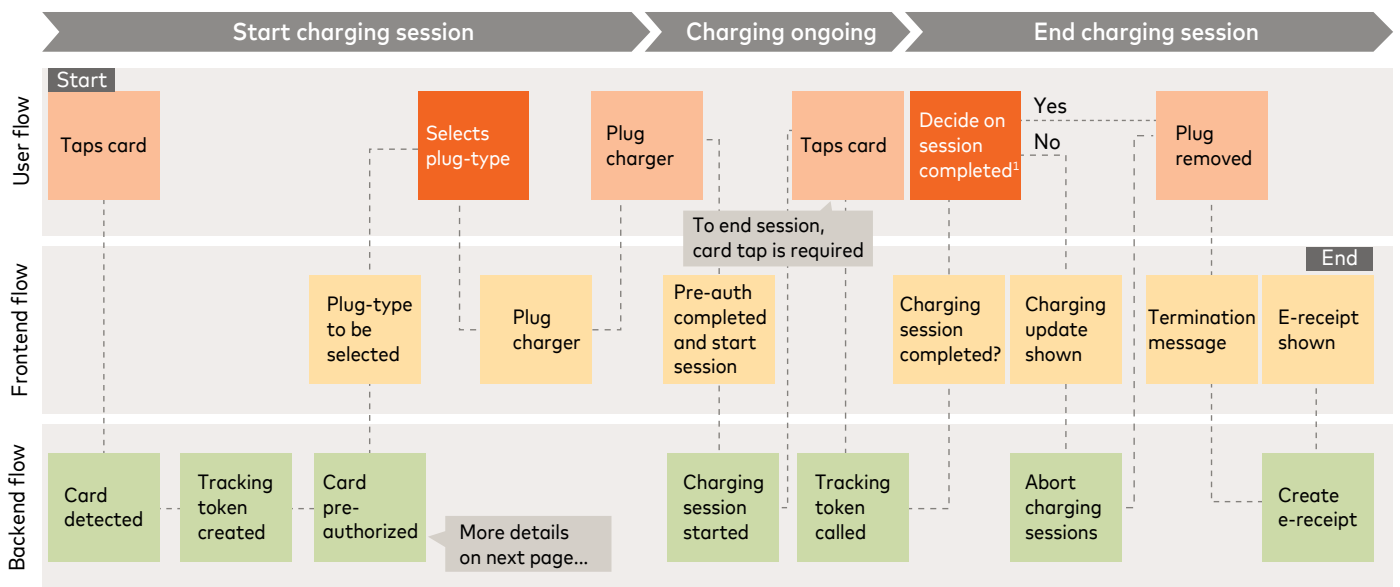
A completed charging session is defined as the battery being fully loaded (100%) – everything below 100% is defined as a non-completed charging session that needs to be aborted

Card-based payments dictionary

EV charging payment specifics

Incremental	An incremental authorisation refers to the amount of an EV charging transaction that is higher than the pre-authorized amount. In this case, the incremental amount is again processed for authorisation through the processing chain
MCC 5552	MCC 5552 is the Merchant Category Code for EV charging payments. Transactions under this code are able to leverage pre-authorisation and incrementals to facilitate typical transaction behaviour for EV charging
Partial approval	A transaction where the issuer approves a part of the transaction amount, typically because of insufficient funds. If handled correctly, the partial approval allows the driver to charge up to the approved amount, rather than having the transaction declined because of insufficient funds
Pre-auth	Pre-authorisation (or pre-auth) refers to the process of authorising a pre-set amount before starting the charging session to secure the funds. After the final amount is confirmed, any excess funds are released to the cardholder by initiating a reversal message to the card issuer
SCA	Strong Customer Authentication (SCA) is part of PSD2 regulation and dictates that, under certain conditions, payments transactions should be authenticated by the cardholder with 2FA. Whereas exemptions exist for parking and vending machines, no such exemption exists for EV charging.
2FA	Two-factor authentication (2FA) Refers to authentication of transactions using at least two different factors of the following: 1. Something you have, for example, a card 2. Something you know, for example, a PIN code and/or something you are, for example, a fingerprint

Key POS terminal concepts

Attended and unattended terminals	Payment scheme regulations differentiate between attended and unattended terminals. For example, SoftPOS is currently not allowed in unattended settings. Attended terminals are those that are overseen and operated by an individual (like at a typical shop counter). Unattended terminals are not overseen by an individual, like a terminal in a vending machine. As such, EV charging payment terminals are unattended terminals.
Contactless limit	Contactless-only transactions (that is, without entering the PIN code) make use of a specific exemption for low-value transactions within SCA regulation (as only a single factor is used for authentication). The contactless limit is the maximum transaction amount or count (counting of number of consecutive contactless-only transactions) for which contactless-only transactions are allowed. This is typically €50 and five consecutive transactions. Due to the smartphone capabilities to verify fingerprints (delegated authentication) the contactless limit does not apply for Apple Pay and Google Pay.
Online and offline PIN transactions	In most markets, the PIN is (after entry by the cardholder) forwarded to and validated by the issuer. This is called an online PIN transaction. However, in some markets, for example, the U.K., the PIN is validated against the PIN information that is contained within the chip on the card (offline PIN verification). As a consequence, a contactless transaction cannot be followed by PIN entry in offline PIN markets as the information to validate the PIN against is only available on the chip. In such markets the payment terminal requires a chipcard reader.
Terminal certification	For terminals to be used in card transactions, they need to be certified against PCI standards. This concerns both certification the hardware, so called Level 1 and Level 2 certification, as well as certification of the acquirer integration (called Level 3).

Point-of-sale terminals

Contactless-only terminal	Contactless-only terminals only have an NFC interface for the reading of contactless card, so no PIN-pad, chip-reader (where you insert the card in the terminal) or magstripe reader. As a consequence, only contactless cards are accepted and only transactions below the contactless limit will succeed. These terminals are a suitable option for operators whose primary business is parking with EV charging as additional service.
Pin-on-glass terminal	To enable PIN entry without installing a separate PIN-pad, PIN on glass enabled terminals allow PIN-entry on the touchscreen of the payment terminal. These terminals are typically lower cost than regular terminals.
Regular terminal	Regular terminals are the ones typically seen on shop counters. They support contactless, chip reader and PIN entry on the same device (and potentially mag stripe). Regular terminals may be integrated with the cash register or operated stand-alone (that is, manual entry of the amount)
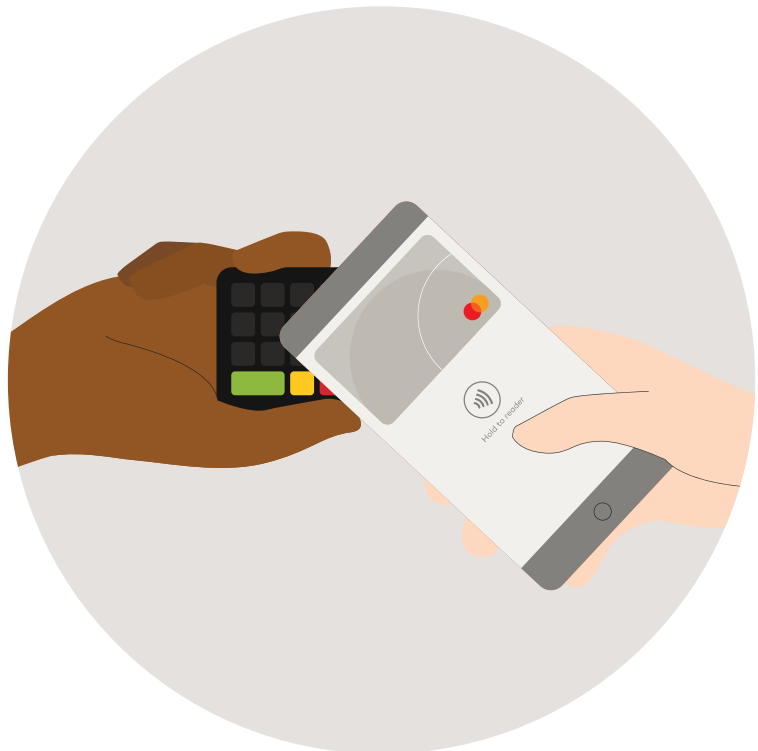
How to integrate card-based payments on a EV charger?

Although there is a wide variance of different approaches and use cases to support card-based payments on EV chargers, below is a high-level overview of steps that need to be taken:

1. Design customer journeys and channels
2. Assess what payment methods to offer and design payments solution
3. Select and contract suitable PSP and/or acquiring partner(s) including selection of payment terminal
4. Perform integration of POS device with charger and/or back-office
5. Perform testing and prepare customer support
6. Launch payments solution

Pre-authorisation best-practices

One of the particularities of EV charging payments is the use of pre-authorisation to reserve the charge amount at the start of the session (as the final amount is at that time unknown). As pre-authorisation often raises questions with both consumers and merchants alike, there are a number of best-practices to optimize customer experience:

- Identify EVC transactions with MCC 5552 (Electric Vehicle Charging), or if the merchant's primary business is to operate an automobile parking lot or garage, MCC 7523 (Automobile Parking Lots and Garages).

- Use the appropriate cardholder-activated terminal (CAT) level indicator to identify each EVC transaction. For a magnetic stripe, contact chip, or contactless transaction occurring at an unattended point-of-sale (POS) terminal, use a value of CAT 1 or CAT 2, as applicable. For an electronic commerce (e-commerce) transaction initiated using the merchant's digital application, use a value of CAT 6.

- Support the partial approval of magnetic stripe, chip, and contactless EVC transactions, effective October 20, 2020, at EMV 1 certified terminals and effective April 1, 2023, at all terminals.

- Identify the authorization request message as a pre-authorization if sent before charging begins, and as a final authorization if sent after charging is completed.

- Ensure the merchant obtains cardholder consent to any estimated amount to be authorized.

- Assure the pre-authorization amount is sufficiently high to prevent incrementals, which may in turn trigger PIN entry requests and customer friction.

- Either send a partial reversal or present the transaction for clearing within 24 hours, or if the cardholder cancels the transaction, send a full reversal within 24 hours. Note that Pre-authorization should never be followed by a Final Authorization. Instead, proceed immediately to clearing or reversal.

- Enable dynamic pre-authorization where the amount of pre-auth is determined by the type of car (as indicated by the car when connecting the charging cable).

In the following section a number of case studies are provided that share the experiences with card-based payments of some of the frontrunner CPOs and hardware manufacturers.

05

Case studies
First movers show benefits
of card payments
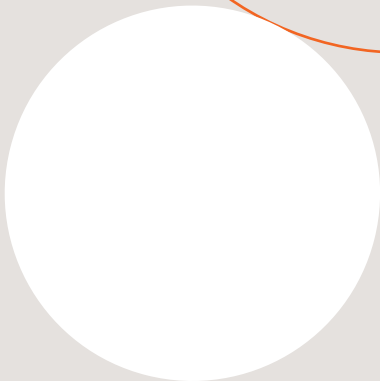
Fastned's transition to open loop (card) payments

CONTEXT AND CHALLENGE

Fastned's mission is to give freedom to electric drivers and accelerate the transition towards sustainable mobility. The way they have gone about this has always been to make charging as easy, accessible and (price) transparent as possible. Fastned solely operates fast charging stations on high traffic locations, and they serve all EV drivers that need a charge. Their goal is to have one thousand stations by 2030, as of the beginning of 2023 they operate over 250 charging stations in six European countries: the Netherlands, Germany, Belgium, France, the U.K. and Switzerland.

When it comes to payments, they want to offer complete freedom of choice to their customers in how they pay for their charging sessions. So next to offering payments through the Fastned mobile application, EV charge cards, QR code and their jointly developed Autocharge solution, they decided to also start supporting ad hoc card payments at their chargers.

SOLUTION AND ROLLOUT

Fastned is rolling out payment terminals on their existing infrastructure (1,326 chargers) since 2021 and currently 200 of them are equipped with a payment terminal from Payter. The rollout was on hold for few months as Fastned was waiting for a new terminal model to be developed, Payter Apollo, that supports a PIN on glass solution. This means that EV drivers can always enter a PIN code and are able to authenticate the payment securely, even if the cumulative limit of the debit or credit card is reached. During the rollout and for the remainder of Fastned's infrastructure that does not have a payment terminal yet, QR code is the payment method of choice for ad-hoc or guest payments.

RESULTS

United Kingdom

Fastned has 13 charging locations in the U.K. and six of those locations are currently equipped with terminals for open loop card payments. The first payment terminal was installed in May 2022 and the latest of those six in February 2023. The numbers show that in all of those six locations almost immediately 25% of the charging sessions are paid using a debit or credit card on the payment terminal on site, showing that for those EV drivers the preferred payment method is an open loop card payment. Fastned expects that these numbers will grow due to the growth of private EV ownership.

Switzerland

In Switzerland, Fastned is seeing similar numbers. They recently equipped all three charging locations in Switzerland with payment terminals, the first in September and October 2022, and the latest in January 2023. From the charging sessions delivered on those locations, 35% of the payments are made with an open loop card on the payment terminal on-site. The results indicate that for those EV drivers the preferred payment method is an open loop card payment.

U.K.

25%

75%

Switzerland

35%

65%

■ Debit or credit card ■ Other
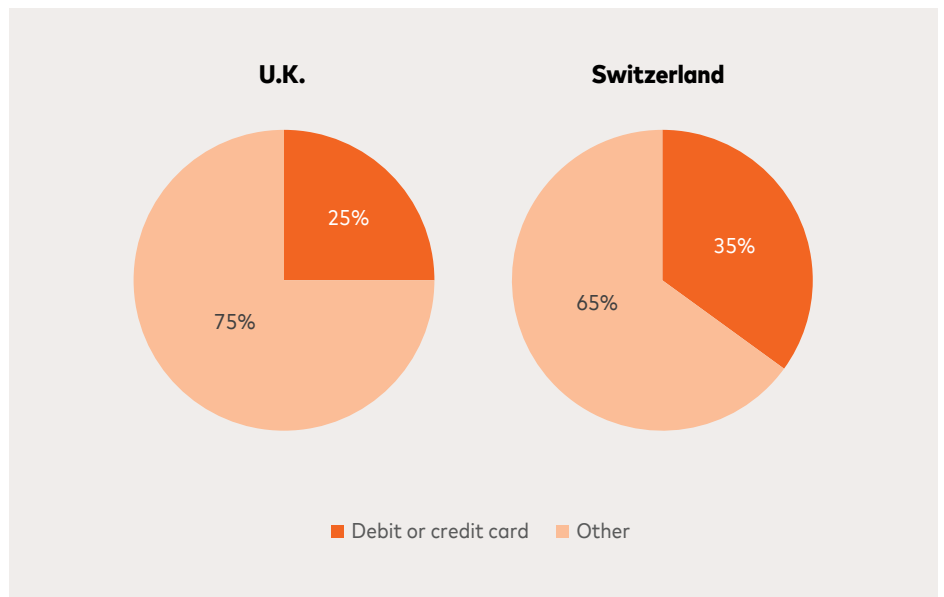
LEARNINGS

Being one of the first movers in equipping their infrastructure with payment terminals, Fastned experienced some valuable learnings.

- Integrating the payment terminal and managing the different payment parties involved in handling the payments is new to most in the EV charging industry. Vice versa, for most in the payments industry it's also new to work within EV charging. Hence, working with a proven set-up if possible is recommended.
- A full cloud integration, meaning that the terminal is controlled by the backend rather than a local integration between terminal and charger, is recommended in order to have complete control over the experience and thus the quality of the solution for customers and Fastned alike.

Fastned strongly believes in putting the customer first and to make sure charging is easy, welcoming and hassle-free for everyone, they are steadfast in enabling open loop card payments across their entire charging infrastructure, independent of regulatory requirements.

"Hello,

We just charged our car in France (Jardins des Causses about 35 km from Cahors), and I want to say thank you. It was easy and not too expensive. A delight! We are not very interested in memberships and such (I hate apps) so it was just so easy and wonderful ... I am just so grateful for a super experience. All the best."

– Fastned customer testimonial

CONTEXT AND CHALLENGE

Kreisel Electric is an Austrian company that has developed a patented immersion cooled high-voltage battery system for electrification projects. For the EV charging market they manufacture the CHIMERO, a commercial high powered charging station that enables up to 180 kW charging on a low grid connection with the support of their integrated battery.

Kreisel supports the integration of open loop card payments for the EV charging industry because they believe it is beneficial to EV drivers. Which means that independent from regulation, their infrastructure would have been fitted with an integrated payment terminal. Kreisel partnered with CCV for this because they have a strong reputation in the payments industry and various solutions for EV charging. One of CCV's core values is to co-create and adapt their product to the needs of their customers and they have been doing that with many EV charging integrators.

SOLUTION AND ROLLOUT

Kreisel and CCV started working on an integrated product about a year ago and recently completed the integration of CCV's IM30 payment terminal in Kreisels CHIMERO. This integrated product is now ready for delivery to Kreisels customers (CPOs). Next to the IM30, also CCV's IM15 will be integrated with Kreisels hardware and both these terminals support PIN on glass functionality. This means the EV driver is able to authenticate their debit or credit card with a PIN code on the hardware, making it possible to always pay, even if the cumulative limit of contactless payments is reached.

It is at the discretion of Kreisel's customers to enable the payment functionality and to start accepting open loop card payments for charges. In case they want to support this functionality CCV will take care of the acquiring and processing of the payments. Enabling this is very straightforward and either Kreisel or CCV will provide a contract to Kreisel's customer, and the payment functionality can be activated the same day. CCV is currently covering 16 European countries, but entire Europe can be enabled.

LEARNINGS

Kreisel

Since payments is a new topic for many EV charging integrators, creating a solution for Kreisel's hardware was a very deliberate process which took Kreisel and CCV about a year. Kreisel's experience is that their customers (CPOs) do not want to worry about the payments piece, so integrating it directly into the charging infrastructure and the ease of activating it through CCV really supports their vision of making the experience as seamless as possible for their customers and consequently for EV drivers.

CCV

CCV has been active in the EV charging industry since 2017 and they have a strong footprint with about 10 thousand payment terminals deployed to partners in the field. During their journey they have been able to gain valuable experience and best practices, for example:

- Working closely with Mastercard and Visa to make sure all players in the payment value chain use the right merchant category code (MCC). This code enables the correct use of the pre-authorization and final authorization process. In the case of CCV it makes sure that the reserved amount, minus the final authorization amount, of the cardholder when paying for a charge is released and instantly available again. It is not uncommon in the industry that this can take up to 72 hours.

- CCV makes sure that all their integrators (customers) are certified, which consequently means that their customers (EV drivers) have a smooth and seamless payment experience during a charging session.

- The integration of German calibration law, Eichrecht. This law requires all components involved in the collection and processing of energy to operate in a trustworthy and transparent manner. CCV solved this by showing a QR code after charging and by scanning this code the EV driver is able to access their receipt and Eichrecht-token and have that sent to their email address. Or you can easily find this information on our website by entering the timeframe and the last four digits of your card number.

CCV IM30
At a glance
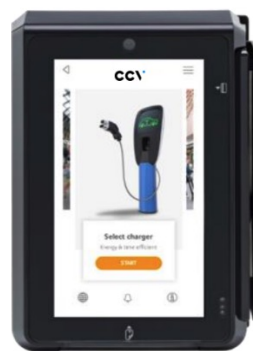
Virtual PINpad
Optimizes use of space

Contactless reader
Embedded in screen

Mag-stripe reader
Read a wide range of cards

Insert chip reader
Angled card insert reader slot

3-in-1 terminal

Additional information:

CCV IM30

CCV IM15

Kreisel CHIMERO

CONTEXT AND CHALLENGE

Atlante, a company of NHOA Group, is on a mission to develop the largest fast and ultra-fast charging network in Southern Europe, enabled by renewables, energy storage and fully integrated with the grid. Atlante aims to have 5 thousand fast charging points online by 2025 and 35 thousand by 2030. Atlante installs and operates charging stations on or near highway locations and on high-traffic locations like airports, city centres and shopping malls and today has over 2.6 thousand charging points live or under construction.[21] As a CPO, Atlante is hardware agnostic and leverages different types of chargers.

Atlante aims to develop an open EV charging infrastructure where all drivers are able to charge. Today, Atlante is accessible for virtually all eMSPs through roaming agreements with Hubject and Gireve. However, to enable full accessibility, price transparency and flexibility (for example in terms of price review and discounts activities) to customers, Atlante is planning to add open-loop card payments to all its chargers. Atlante envisions a future where multiple payment-options co-exist to provide drivers with choice: Plug & Charge, card-based payments and QR-based options may all be available.

SOLUTION AND ROLLOUT

Atlante started rolling out payment terminals on its chargers in April 2023. The decision has been to pursue an architecture in which the terminals are locally (directly) integrated with the chargers, as this has been identified as the current standard in the charger manufacturing industry. The roll-out started with the Self/2000 (Ingenico), integrated by Alpitronic on their Hyperchargers. Other charger manufactures integrate different devices, such as IM30 (PAX), Apollo (Payter). Atlante performed a selection and negotiated direct contracts with the payments gateway and acquirer. This decision was intended to ensure technical agnosticity with respect to the payment terminal provider selected by the specific charger manufacturer. In future deployments, Atlante will also consider back-office integration of the terminals, to separate the selection of the payment terminals by the decisions of the specific manufacturer, and to unlock one-to-many set-ups, where a single terminal will be leveraged for multiple chargers.

RESULTS

First deployments are just going live by the time of writing this white paper, so no results are available yet.

LEARNINGS

Although Atlante is still in the process of roll-out, there are already a number of learnings to be shared:

- As a CPO launching card-based payments in multiple countries, Atlante has observed there is a lack of standardization of regulation across countries. Not only does it remain unclear if card-based payments will be forced by the EU; additionally there is numerous national regulation, for example on billing, taxation and receipts, that complicate international execution.

- In face of regulatory uncertainty, it is crucial to closely monitor regulatory developments on both national and European level.

- There is a lack of knowledge and standardization on card-based payments in the EV charging value chain (among others with hardware manufacturers).

Public transit: Transport for london

CONTEXT AND CHALLENGE

When looking at the enablement of open loop card payments within the EV charging industry the comparison with public transport is easily made. Until recently, practically all public transport networks globally only supported the use of closed loop payment systems with dedicated cards, tags or other ways to pay. However, there are numerous cities around the globe (e.g. London 2012, New York 2021, Sofia 2021) that have rolled out or are piloting with adding open loop card payments. And more recently the Netherlands has started to roll out in the entire country with OVpay.

The rationale to introduce open loop payments in public transport is clear and with the proliferation of contactless cards it makes sense to extend the use case beyond payments at the point of sale. From a consumer perspective the convenience of being able to use your contactless debit or credit card for public transport is obvious: no more pre-payments on a closed loop solution and traveling as a tourist becomes super easy and less confusing. Also from a transport organisation point of view, the benefits are clear: less queuing means better flow of travelers, less ticketing and expensive infrastructure, less cash to handle and less personnel which all lead to the same conclusion: lower cost to the transport organisation.

SOLUTION AND ROLLOUT

This year, Transport for London (TfL) celebrated a decade of contactless payments in public transport. So it's worth taking a look at how this was introduced and how the adoption has developed in the years after introduction. The aim of TfL was to reduce the cost of ticketing and therefore they wanted to open up acceptance in public transport. Since there are many stakeholders to make the solution work, TfL initiated a payments industry forum where all parties involved came together and where the model to support open loop payments was developed and agreed to.

Together with TfL, the U.K. Finance Association, issuers and acquirers and Mastercard played an important role in the enablement by introducing the PAYG model. Scheme rules for PAYG were implemented on all networks to start supporting EMV payments in transport. The same safe and secure technology that is globally being used by banks and card schemes.

RESULTS

A decade after the introduction of TfL's PAYG, approximately 70% of journeys are made with a contactless debit or credit card, Apple Pay and Google Pay. This percentage of contactless journeys seems to be leveling out since there are certain groups that will still be using the Oyster card system due to the fact the contactless card system does not support specific use cases and concessions for seniors, students and children. Overall, we can conclude that ten years after introduction the majority of travelers prefer to use open loop cards compared to the Oyster card.

Transit for London: Number of bus, tram and rail journeys combined

— Contactless transactions — Oyster card transactions
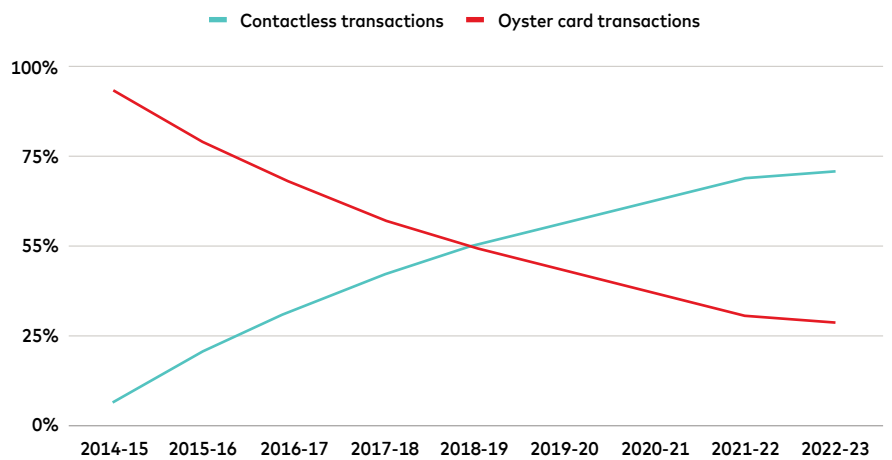
LEARNINGS

TfL's PAYG solution evolved from the successful Oyster card and was developed in collaboration with Mastercard and the involvement of the wider banking industry. The idea behind it was to reduce costs for transport operators and to offer travelers the same seamless and frictionless experience they have when paying contactless in stores.

When comparing open loop acceptance in public transport to enablement of open loop card payments in the EV charging industry there are many differences. However, there are also similarities like: the fragmented landscape of operators and protocols, and the many different stakeholders that are involved in creating a solution. From the traveler or driver's perspective, the benefits that can be had when multiple cards, apps or using QR codes are no longer necessary and simply your debit or credit card can be used.

The learnings and best practices that are also applicable to EV charging:

- The benefits of coming together as industries and starting the conversation with EV stakeholders like OEMs, CPOs and eMSPs with companies that facilitate payments such as Mastercard, terminal suppliers and (acquiring) processors will be beneficial for implementing payment solutions.

- Standardization of technical requirements such as merchant category codes and certain regulatory requirements for EV charging have to be implemented by all parties in the payment value chain to assure a smooth user experience.

- Interoperability and scaling: Similar as in public transport, the stakeholders in the EV charging ecosystem strive for a seamless payment experience for EV drivers when charging and especially when roaming. And with the proliferation of EVs, kilometres driven and thus the growth of EV charging infrastructure, solutions are necessary that can easily support guest payments.

- Cost savings: The cost of having to support and maintain multiple means of payment as a CPO can be a reason for opening debit and credit card payments since this is the most commonly used payment method globally.

- Security: Using EMV technology is a proven and safe way of paying that ensures that the entire infrastructure, from front-end devices to the back-end systems, is compliant with the security standards required by the banking industry.

There are still many challenges to be addressed by the industry, but regulation and EV drivers' preferences are already pushing towards the acceptance of open loop card payments in EV charging. Currently, the key is on educating the industry and bringing together the stakeholders to create fit for purpose solutions, similar to what has been done in the public transport case.

06

Innovation will further improve charging experience
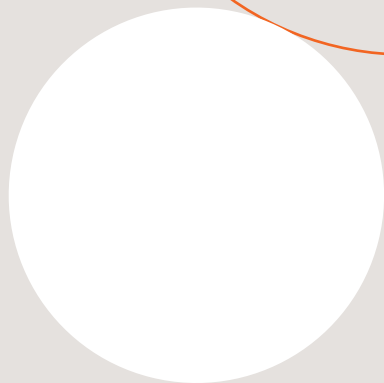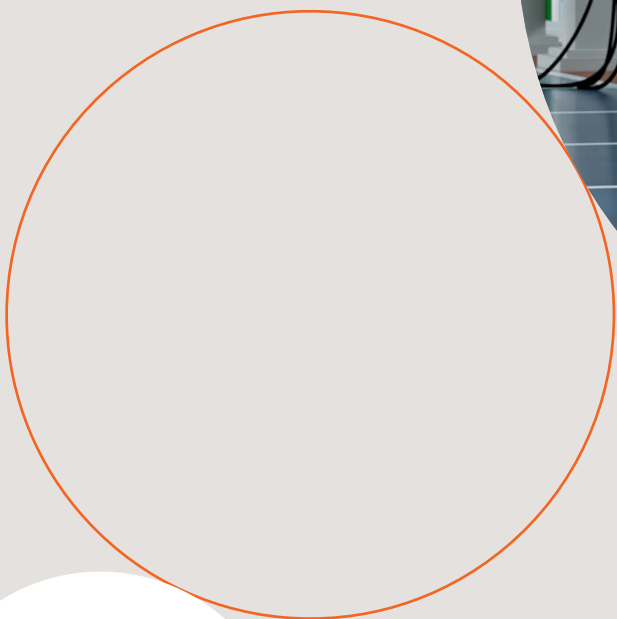
Innovation across charging, payment, regulation and consumer behaviour will enable new experiences

EV charging payments are just starting to take off. As more and more vehicles hit the road, and future growth becomes locked in into regulation, the case for innovation towards even better user experiences gets stronger and stronger. Innovation across charging, payments, regulation and consumer behaviour creates new opportunities to improve customer experience and value within the EV charging value chain.

Charging

Plug & Charge

- Plug & Charge enables charging by only plugging in the cable.
- Enabled by ISO15118, where authentication takes places by identifying the vehicle through the plug.

Smart charging

- Smart charging enables dynamically balancing charging over time to optimise for example, energy cost or grid balancing.

Vehicle-to-grid

- Vehicle-to-grid refers to the offloading of energy from the EV battery to the grid to enable grid balancing.
- Essentially, this way EV batteries can serve as batteries on the grid.

Regulation

AFIR

- Alternative Fuel Infrastructure Regulation (AFIR) sets ambitions for charge point infrastructure development and payment methods.
- Definitive version expected in second quarter of 2023.
- See page 3 for more details.

PSD3 and SCA

- Current PSD 2 regulation dictates, via Strong Customer Authentication (SCA), that a PIN code should be entered for some card payments.
- PSD2 is currently under review, a proposal for PSD3 is expected in summer 2023.
- An exemption from SCA for EV charging, removing the need to install PIN pads, is likely to be on the table in the negotiations for PSD3.
- However, it will probably take until 2025-2026 before this is concluded.
- Additionally, PSD3 is likely to regulate closed-loop payment schemes in line with open-loop schemes.

Payments innovation and corresponding Mastercard solutions

Card-on-file and tokenisation

- Card-on-file enables seamless customer experiences by saving payment credentials for e-commerce transactions.

- Often, the payment credentials are replaced by a restricted use token for security.

- Card-on-file is often used for recurring payments; research shows that up to 41% of recurring transport payments are made by card.[22]

- Mastercard's card-on-file solution is called Secure Card on File.

Account-to-account payments

- Open Banking refers to the increased interconnectivity of payments and banking, where third parties (not being banks) are enabled to access account information and initiate payments on behalf of the accountholder.

- This creates a level playing field where new solutions can be developed; examples include financial planning tools and new payment solutions that enable account to account payments.

- Aiia by Mastercard enables Open Banking by providing an instant connection to more than 3 thousand European banks.

- In more and more countries, transfers from one bank account to another become real-time.

- Combined with Open Banking, this enables the use of account-based payments for commerce for specific use cases.

One-click check-out

- One-click check-out, leveraging card-on-file technology, enables consumers to check-out with a single click.

- This increases speed of check-out for consumers up to nine times.[23]

- Click to Pay is the EMVCo solution for one-click guest check-outs.

In-car payments

- Connected cars enable cars to become payment devices.

- By uploading card credentials in a driver profile and delegating authentication to the car, the driver can pay for services from the navigation pane.

- Mastercard collaborates with the automotive ecosystem to make in-car payments reality.

One-to-many terminals

- New terminals enable one-to-many set-up where a single terminal supports payment for multiple chargers on a charging location.

- This way, terminals costs per charger/charging session can be significantly reduced, which is especially suitable for lower traffic locations.

Push to card payments

- In the platform economy, pay-outs are increasingly important, for example, to pay out to sellers on marketplaces.

- In order to enable easy pay-outs, payment providers are developing Push to card solutions where funds can be pushed to any given credit or debit card based on the card credentials (essentially the reverse of a usual payment transaction).

- This removes the (error prone) entry of bank account information and simply leverages the card information that is typically already in place and verified.

- Additionally, the receiver has almost instant access to the funds, whereas bank transfers may take days to complete.

- Push to card can be leveraged in EV charging to push funds to drivers to compensate them for vehicle-to-grid connections.

Enabling open-loop card payments, provides access to payments-related value-added services with innovation in data, loyalty and cyber security beyond the payments innovation depicted above.

Consumer behaviour

Charging commerce

- As charging becomes part of daily routine, evaluation of charging options becomes part of selection of parking places and destinations.

- Here, new opportunities to create innovative offerings combining charging, parking and commerce arise.

Shared mobility

- Consumers increasingly move from ownership to shared mobility options.

- Consumers have access to more mobility modes than before, but often don't own them.

- New providers and platforms facilitate access and payment.

Omnichannel

- New combinations between physical and digital transaction arise

- Examples include enrolling a payment card for a (card-on-file) subscription by tapping the card on a POS terminal (NextGen POI)

07

How to get started?
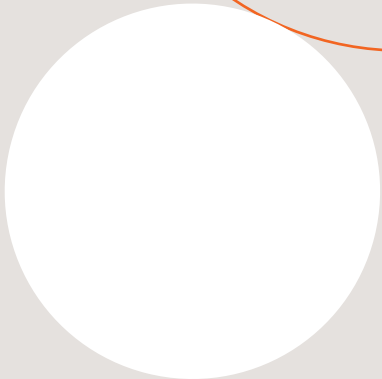
CONCLUSIONS

This whitepaper has shown the many opportunities for innovation in EV charging payments. The EV journey has only just begun, and there are many developments ahead. While the short-term imperative is to ensure interoperability of the current infrastructure leveraging a unified and standardized payment infrastructure, innovation will enable drivers with greater choice to have the seamless and convenient charging experience they prefer.

Mastercard and PaymentGenes support the transition to electric-powered mobility. Mastercard leverages its vast payments experience and network to enable new payments use cases. Partnering with the EV charging value chain, including hardware manufacturers, CPOs, eMSPs and charging location, is crucial to assure relevance for all. PaymentsGenes delivers payments consultancy and recruitment services that enable the EV charging value chain to effectively grow and deliver on the required green infrastructure needs.

Get in touch

Developing the EV charging experiences of the future is a collaborative effort. Mastercard and PaymentGenes are keen to have an open conversation with the EV charging ecosystem on how to shape the future of EV charging payments, and how to get started tomorrow. Examples of questions that we would like to explore that could be top-of-mind include:

- How to shape an optimal omnichannel payments solution?
- What opportunities do payment innovations bring to my business?
- How to shape a (mobility) card offering that fits my business needs?
- How to enhance overall user experience through payments ?
- How to create opportunities by combining commerce and charging?

You can find us here:

- Join our informative EV charging payments webinar
- Get in touch with the authors to discuss
- Follow us on LinkedIn for updates:
  - Mastercard
  - PaymentGenes

End notes

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