EVRoaming Foundation
Realising cross-border charging

White paper

Issues and solutions for better exchange and understanding of EV charging tariffs

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RATES (SET BY STATION OWNERS)

$15.73/hr: Maximum power of 50 KW; $31.45/hr: Maximum power of 50 KW, State of charge above 90%; $19.95/hr: Maximum power of 60 KW; $24.18/hr: Maximum power of 70 KW; $28.41/hr: Maximum power of 80 KW; $32.64/hr: Maximum power of 90 KW; $36.87/hr: Maximum power of 180 KW

Dutch pricing benchmark research 2023
"The average loading score decreased slightly from 6.3 to 6.0 compared to 2021 (red. on scale of 0-10). This has several causes.
*•**less clarity about the charging price in advance:** the price was known in advance for 73 percent of the charging sessions - via the app, website or at the charging station itself - in 2021 this was still 81 percent.*
*•**accuracy of invoices decreased:** the price on the invoice was correct in 80 percent of the charging sessions, in 2021 this was 98 percent.*
*•**which did improve:** more invoices provide a clear price specification, 50 percent compared to 10 percent in 2021."*

0,27273 €/kWh until the end of charge, detected when less then 100Wh are consumed on a 5 minutes period
Then
0 €/min after the end of charge, limited for 30 minutes
Then
[0,00826 €/min the additional minute in the time interval 8am - 8pm
And
0 €/min the additional minute in the time interval 8pm - 8am]

Preface

This document is the result of discussions with many parties in the market during almost a year. It is based on the current situation, knowing that there will be situations in the future that can result in a different or new view regarding price transparency.

This document is not the end, it is the beginning.

Input, remarks and comments are very welcome and can be sent to operations@evroaming.org

Updates/next versions

Based on new or changing developments, insights, experiences, research and feedback on this document, yearly updates will be made by the EVRoaming foundation, together with its contributors.

Summary

A recent benchmarking study towards the situation around price transparency in The Netherlands executed by the Knowledge Institute for Charge infrastructure show that status and quality of price transparency went backwards compared to a similar study two years ago. Other research and sounds in the market show that this is not unique. The market becomes more complex and it seems to be hard in that market to improve price transparency.

The EVRoaming Foundation aims to support accessibility of charging infrastructure in the best way possible. This is done by maintaining and developing the OCPI protocol, but also by assisting the market with ways to improve accessibility.

Together with a large group of contributors of the EVRoaming Foundation from all over the world, a guidance document has been created to describe the challenges around tariffs and pricing of EV charging infrastructure. The document describes the challenges and give recommendations how to improve these challenges. The document contains three main parts: CPO – MSP situation, MSP – EV driver situation and the situation around tenders and requirements from governments and other organizations.
The recommendations are put together in this summary.

It is important to note that the EVRoaming Foundation is not against the use of flexible or dynamic tariffs. If they are used, do it in a right way and be sure it is communicated to the EV drivers.

Part 1: CPO – MSP
Recommendation: technical connectivity
Always use a good technical connection and protocol to your partners for publishing and sharing tariffs. If you're using a roaming hub ensure this hub can handle the tariffs in the right way.

Recommendation: inefficiency large number of tariffs
Use Fixed tariff sets as much as possible and re-use them; don't use a separate tariff set with separate tariff ID for each charge point or station.

Recommendations: changing tariffs / variable tariffs

1. *The CPO must set the tariff changes for the MSP at latest 10* hours before it is applicable, so that the MSP has enough time to inform the EV driver, which should be at least 8* hours before it is applicable. This includes changes on the already known parameters by the MSP (time of use €/kWh, idle fee €/time, etc). Exemption: If dynamic tariffs are applied, it must be based on clear customer consent, and therefore activated between CPO and MSP, CPO is able to change tariff ad hoc. See also Recommendation 4.*
   (=these periods are based on information from the market what the latest moments can be that their own tariffs are known and that they can determine the tariffs for their partners: MSPs or EV drivers)*

2. *The CPO should inform the MSP about any other tariff mechanism which occurs based on real time insights (e.g. dynamic fees based on utilization or idle fees). The CPO has a certain freedom to apply for the following mechanisms, but is obliged to communicate this transparently to MSP and EV drivers: in time and in line with the previous recommendation.*

3. *For public charging and without explicit agreement between CPO, MSP and EV driver a CPO must not use energy spot pricing (= pricing based on actual energy cost at a certain moment) to MSPs and MSPs should not use energy spot pricing to EV drivers The goal of spot pricing is to push energy usage that is not time sensitive to off-peak hours, and implement load balancing on an international level. This works for utility contracts, under the assumption that smart appliances and charging stations can receive the spot pricing via an API, and plan their energy usage without*

human intervention. It is questionable if in situations of public charging people will change their travel plans based on spot prices of the day. The amount of tariff IDs will also explode as all tariffs need to be created and stored for auditing and historical reasons.
For private charging the situation can be different.

4. *Dynamic tariffs can be used if:*
    a. *It doesn't introduce too much complexity.*
    b. *It can be represented using the existing tariff restrictions.*
    c. *It is still relatively straightforward to communicate the kWh consumption rate for each time window of the day to the user.*
    d. *Users can still estimate the cost of their session before starting the charge*
    e. *It could easily be extended to include validity periods via start_date_time/end_date_time.*
    f. *A CPO transparently communicates in an electronic way via protocols to the MSPs, the parameters based on which dynamic tariff mechanisms will be activated.*
    g. *CPO and MSP have a contract in place to enable a MSP to activate dynamic models (i.e. opt-in for spot prices, opt-in for utilization based fees)*

    Example: peak and off-peak hours and tariffs (i.e. dynamic tariffs) that are known and can be sent by the CPO to the MSP at least 10 hours before it is applicable. See also recommendation 1.

5. *Every CPO is obliged to actively push a warning/notification to the connected market parties to make them aware of:*
    a. *price update*
    b. *time and day of enforcement*
    c. *affected price sets or - components (or IDs)*

<u>Recommendation: issue changing tariff with same tariff ID</u>
A Tariff (tariff ID + tariff) must not be changed once it has been published.

<u>Recommendation: many tariff components</u>
1. *A charging tariff should not contain more than 3 different components. Not between CPO and MSP and not for EV drivers.*
2. *The setup of tariffs by CPO to MSP should be used in the same way for MSP - EV driver tariffs. This does not mean that the MSP - EV driver model must be based on the CPO-MSP model, but the CPO-MSP model should not be so complex that it can't be used for EV driver tariffs.*

Part 2: MSP/CPO and EV driver
<u>Recommendation: translating CPO-MSP tariffs into EV driver tariffs</u>
Very complex tariffs structures between CPO and MSP result often in more simplified, but relative high EV driver tariffs. This is not in the benefit of the end user, but also not the CPO or MSP. It is recommended to take that into account when defining tariff structures.
If the MSP is forwarding a complex CPO-MSP tariff, with or without margin, to the EV driver, it is recommended to add some warning by the MSP that the tariff structure might be hard to understand. This is already done in certain situations, and results in more simplified tariffs between CPO and MSP.

<u>Recommendations: information to EV drivers before charging</u>
- *Make sure EV driver tariffs can be found in an easy way, Preferable via the same medium as you do the payment. E.g. if payment is done via (dynamic) QR code, the tariff should also be visible on that page, if payment is done via app, also the tariffs should be visible via the app, etc.*
- *Reduce the number of components in EV driver tariffs (In Europe Ad Hoc charging tariffs are already limited to 3 components based on AFIR)*
- *If a time component is involved, make sure that this is clearly visible and understandable for the EV driver*

- *If there are multiple time components (charging/parking/idle time), it should be clear when exactly which time component is active.*
- *If an MSP applies CPO tariffs outside energy, the actual tariff should be shown and not for example a reference to CPO.*
- *Make sure that shown/visual EV driver tariffs can be changed*
- *Take into account the risks of using static QR codes*
- *Be clear about the VAT. Where the tariff is shown, the tariffs must include VAT and that must be mentioned clearly.*

Recommendation: different tariffs between MSPs and compared to Ad hoc tariff
Take into account regulations (e.g. competition laws) if you differentiate pricing between MSPs or between CPO Ad hoc tariff and the CPO MSP tariff, for the same service.

Recommendation: tariff comparison between different providers
To support comparison of EV driver tariffs, it is recommended that MSPs and CPOs:

- *Make very clear what they mean with used terms for tariffs and their components*
- *Use at least in their own communication to the EV driver everywhere the same terms*
- *Reduce complexity of tariffs, which would make it harder to compare*

Recommendation: follow the cost during a session
If a charger has a display, make sure that at least progress of the different components (often kWhs and time) are shown. In case of Ad hoc access with direct payment, also the cost of the session should be shown during charging.
If an app or other messaging service is used the different tariff components must be visible including the progress of it during the session. This requires that CPO and MSP exchange session information in an electronic way.

Recommendation: high cost of session because of time component
Inform the EV driver during the session about the status/cost. This can be easily be done by offering to set warnings via app or website when certain thresholds are reached. This can either be:

- *Charging is finished*
- *A certain total cost of the session is reached*
- *Every x minutes a warning or update.*

This is already very common for parking apps. In the EV market however this is not done yet, but highly recommended.
Recommendation: information after the charging session

- *Inform the EV driver as soon as possible when transaction is stopped about the cost of the session by sending a CDR (either by SMS, mail or showing it on display of charger or payment terminal.*
- *Create separate lines for different components on the CDR. Do not combine tariff components as that makes it impossible to verify it with the tariff before.*
- *CDR should include all the necessary elements for billing control by the EMSP*
- *Be clear about the VAT in the CDR.*
- *In case or cross border charging ensure that the used VAT rates (if any) are clear and on the invoice separate it by country where has been charged.*

Part 3: Tenders, Requests for Proposals and Regulations
Recommendation: Awareness – view from EV driver side
Take a view from the EV driver and imagine if any type of person can understand the requested tariff schema. This recommendation is not limited for persons active with tenders and regulations, but for everyone busy with EV driver tariffs.

Recommendation: rules for better understandable tariffs
Limiting the amount of components is one way to reduce complexity.

Clear definitions of possible used components are very helpful e.g. idle fee (time when charging is finished but car is still connected and uses a charge parking spot)
Regulations about flexibility of tariffs during a session make tariffs more understandable and easier to verify at the end, e.g. max amount of different tariffs or that a tariff cannot be raised during the session.

Recommendation: max EV driver tariffs
Be careful by demanding max EV driver tariffs. It can result in undesired situations e.g. when because of unexpected circumstances the cost of the CPO raises. Take into account that the CPO is only responsible for the Ad Hoc EV driver tariff and is never responsible for the MSP-EV driver tariffs, although of course their CPO-MSP tariff has influence on that.

Recommendation: requirements tariffs and max power
Using tariff based on max power, either from a charge point or delivered during a session is extremely difficult to implement, create understandable EV driver tariffs and create a situation that the CDR and invoice can be verified after the transaction. Because of that it is strongly recommended NOT to use max power as bases for tariffs.

Recommendation: requirements smart charging with dynamic pricing and power
When Smart Charging is required in tenders or by regulations, it is recommended to take into account that the CPO (for Ad Hoc) and MSP must be able in a clear understandable way to inform the driver before charging and that they can verify it afterwards. Tariffs and power that can change several times during a session are not supporting that and should either be limited or totally prevented. E.g. the start of a peak hour with changing tariff and power can perfectly be communicated before charging and can easily be verified after charging. Changing power and tariff four times an hour is almost impossible to be informed before and be able to verify it afterwards.
It should also be taken into account that there will be much more acceptance for Smart Charging and dynamic power, when it is clear for the EV driver that he/she is not only punished when not using or accepting it, but also gets benefits when they accept it.

Recommendation: connection tariffs / idle tariffs / rotation tariffs/ occupancy fees (different terms, but all used for purpose to move a vehicle when power transfer of a charging session has finished)
- Time base tariffs meant to move the vehicle after charging, should only be used after charging (100 % State of Charge or to the self set limit) and not during charging (power transfer). In the EU this is already part of the AFIR and that way in all EU countries the only allowed way to use them.
- Municipalities should ensure that these time based tariffs are very clear for the EV driver when they start and stop and if during which period in the night it is not applicable.
- Municipalities should ensure that there are no or very limited different ways it is used in areas of their city.
- When there are car sharing companies active in a city that do not have reserved charging points, it should be offered that time base tariffs do not apply for these vehicles.
- It must be very clear to the EV driver how the municipality and operator decide when the vehicle is finished charging.

Recommendation: signage and price poles
Good signage and price poles can be very helpful for the EV driver, if they are used in the right way. That can be enforced via the tenders and in regulations:
- Clear signage at the location of a charge station should state that it is exclusive for charging electric vehicles and that electric vehicles that are not charging or connected are not allowed to use that place neither other non electric vehicles. Statement that these vehicles can get a fine or be removed is recommended to add on the signage.

Price poles should be required for at least the DC charge stations along the highways, showing the Ad hoc tariffs for the different max power levels.

Part 4: future trends and developments

The EV market is complex with many involved different parties and evolving very fast. There can be new or changing situations that require a different view on price transparency as described in this document. E.g. Plug & Charge, V2G, etc.

It is also possible that future developments have an impact on current described cases. E.g because of new regulations, or different views on how to deal with (dynamic) tariffs for Smart Charging.

These developments and changes will be taken into account in updates of this document.

This document is not the end but a start and can be improved over time.

Pricing transparency remains key for the short term and long term. The EVRoaming Foundation together with the EV industry and regulators will continue to put effort in clear transparent tariffs, invoices and the expected and delivered power for EV drivers.

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Introduction

Does an EV driver know and understand what he/she will pay for the charge session? Often the answer is: “No”. EV driver tariffs are complex which can be caused by many reasons: because of complex tariffs earlier in the chain, by unclear information from the service provider, or by extreme pricing demands and requirements in tenders. Besides that, the way tariffs are dealt with by different parties in the chain and how they are exchanged is not always efficient. As a result of this complex set up and in-efficient exchange, EV drivers often can’t access the actual tariff before the start of their charging session or EV drivers don’t understand the tariff. With smart charging more actors will be involved in the tariff management, which creates risks of even more complexity. If we don’t act and improve now, it will only get worse in the coming years.

This document describes the situation, the issues and proposes solutions on how to deal with tariffs between CPO and MSP as well as towards EV drivers and gives advice on how to deal with it in tenders and regulations.

As there are many issues with tariffs today, the document is also focusing on these issues and proposed solutions for today's situation. Although many scenarios are explained, it is possible that in the future a situation might occur that is not covered in this document. In that case this document can be updated.

This document is focusing on the business processes and not directly on protocols.

However it is important that protocols support the recommendations. It is verified that at least OCPI v2.2.1 can process the recommendations.

This White Paper contains 4 parts:

1. The relation between CPO and MSP and how they should deal with tariffs. This includes also a technical annex on how to deal with the recommendations from a technical perspective. (This is the current released part of the white paper)
2. The relation with the EV drivers and how parties should approach them with their tariffs. This is partially a result of the situation between CPO and MSP, but contains also information about signage, and expectations from EV drivers
3. What governments and other organizations should take into account concerning charging tariffs in their tenders and requests for proposals.
4. Future trends and developments

Position towards dynamic/flexible tariffs

This document does **not** advise not to use dynamic/flexible tariffs. The document aims to get a situation where tariffs can be exchanged in a good way between parties using protocols. And to get EV driver tariffs that can be known before charging, are clear and understandable and where cost of transactions can be verified. Currently we see that both are not always the case. Is it possible to use dynamic/flexible tariffs while presenting it in a clear understandable way? Yes. As described in this document. However, currently there are many situations where dynamic/flexible tariffs are used in a way that can either not be shared via protocols and/or where the EV driver is not able to know the tariff before in a clear and understandable manner. That is what we should prevent.
How you can use dynamic/flexible tariffs in a good way is explained at point 3 and 4 of the recommendations about: Issue with changing tariffs/variable tariffs at a station before charging

Main used terms explained

- Tariff: the amount that needs to be paid per component. E.g.: 45 cent per kWh or 2 cent per minute.
- Tariff component: the type of unit of tariff e.g. kWh, minute
- Tariff set: a group of tariffs that are used for a single charge action

- Tariff ID: a code to identify a certain tariff or tariff set
- Costs: the total amount that needs to be paid for the total session, including all tariffs x used amount.

Goal

There are two goals for this document:

1. Create better understandable, transparent and traceable calculated tariffs for EV drivers
2. Create more efficient, correct and accurate tariff data exchange between market parties (i.e. between CPO's and MSP's)

Target group

This document is important for everyone that has to deal with tariffs in the EV charging market:

- Governments who set regulations
- Everyone that set out tenders for charging infrastructure and include requirements for tariffs
- Charge Point Operators and Mobility Service Providers

Basic regulations on tariffs

A consumer must:

- Be able to know the tariff(s) for charging before they start the charge session
- Understand the tariff and how the costs for the charge session are calculated
- Be able to see the progress and cost for the charge action during a session split per used component.
- Receive an overview of the cost immediately after the charge session, including all components, so that he/she can verify this with the tariffs before the charge action.

Problems in the current situation

There are currently two main problems, regarding charging tariffs:

1. The charging tariff for EV drivers is often not known or difficult to find, unclear, not easy to understand, and hard or impossible to use for verification of the transaction and invoice after the charging activity.

2. Tariff exchange between Charge Point Operators (CPO) and Mobility Service Providers (MSP) is:
    a. Not always communicated by a proper technical connection and protocol
    b. Inefficient and hard to manage
    c. Complex
3. Difficult for keeping track of obligated historical data

By the CPO-MSP tariff setting the CPO often wants to manage charging behavior. However if the MSP does create the EV driver tariffs in the same way, it might not have the intended effect and impact.

Complicated tariffs can be simple tariffs explained in complicated ways.
The EV charging market is growing rapidly and all kinds of new developments are coming e.g. smart charging, dynamic energy tariffs, etc. These developments will raise the problems, if we don't agree on solutions now.

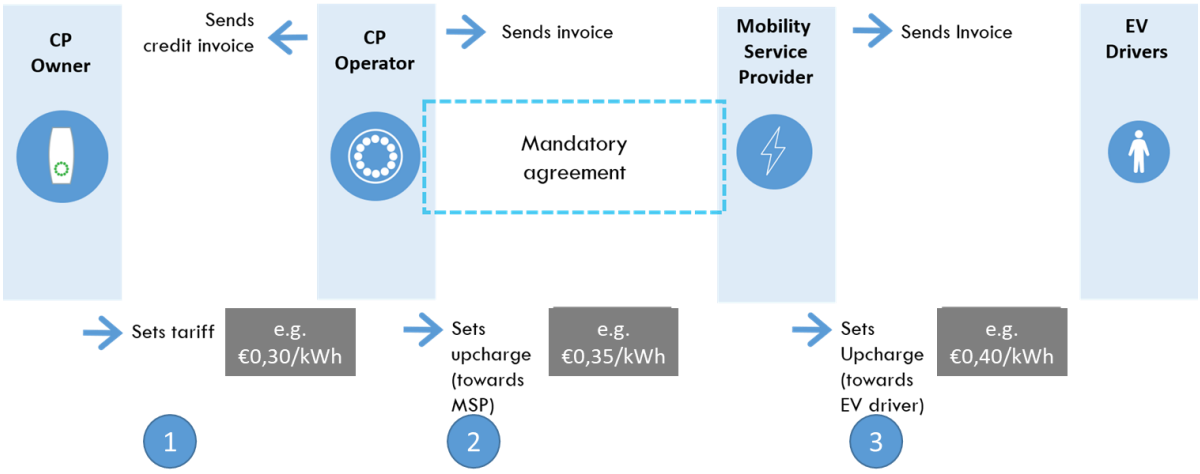
The complexity of tariffs is explained in Annex 1 where a differentiation is made between base tariffs, threshold tariffs, tariff schedules, idle tariffs and combination tariffs. The pros and cons are explained including examples.

This document describes the above problems and proposes solutions in the short term, to be able to further grow as an industry in the near future. The first chapter describes how tariffs are defined. After this explanation, the situation between CPO and MSP is described. In the second part the situation for the EV driver is explained and finally in the last part scenarios are described for current situations in tenders and regulations and how that can be improved. Each part ends with conclusions and proposed measurements.

How are tariffs defined and set?

(The mentioned tariffs in this document can be in any currency. For clarity € is chosen in the examples)

The following overviews show the "tariff value chain" in a basic simplified form:



(The "mandatory agreement" between CPO and MSP is referring to the roaming agreement. An agreement between CP owner and CPO and the MSP and EV driver should also be in place.)

This overview shows that there are at least 3 steps where the tariff is set and modified.
The EV driver tariff is the result of many different tariff components and can contain:

- Start or transaction fee
- Minute fee during charging
- kWh fee
- Roaming service fee
- Parking fee
- Idle time fee (when car is parked at a charger, but not charging)
- Service fee CPO (upcharge CPO-MSP)
- Service fee MSP (upcharge MSP-EV driver)
- Priority fee

The CPO can also offer Ad Hoc access to their public accessible charge stations without the need of using a MSP (this is an obligation in Europe). The transaction is paid with a direct payment system connected to the CPO. The CPO offers an Ad Hoc Charging tariff for the EV driver, which can have the same tariff components as mentioned above, although in most situations it is limited to one or two components.

Part 1: The relation between CPO and MSP

CPO – MSP tariff exchange

CPOs are invoicing the charge sessions on their charge stations to the MSP. This can contain many (sometimes up to ten) different components from kWh to minutes, start rates, etc. There are a huge amount of CPOs and MSPs active in the world. Only in Europe there are already over 1000 of them. In all regions they are connected to each other and exchange the tariffs from CPO to MSP; this is the sales price for the CPO and the cost price for the MSP.

A CPO can have different tariffs for different MSPs. Regulations must be taken into account e.g. in Europe it is only allowed (according to AFIR) when this differentiation is done with clear reasons and not discriminating between MSPs.

Tariffs are not always communicated by a proper technical connection and protocol

Tariff exchange sometimes doesn't happen at all. Every roaming protocol supports sharing tariffs, but there are still CPOs that either don't publish their tariffs, or publish them in a non-standard way (a page on their website, a custom API, ...). The roaming hubs have a lot of technical problems with tariffs too.

Recommendation:

Always use a good technical connection and protocol to your partners for publishing and sharing tariffs. If you're using a roaming hub ensure this hub can handle the tariffs in the right way.

In Annex 2 of this document we explain how you can deal with the main issues and recommendations on protocol level, including some examples. It is explained with OCPI v2.2.1.

Inefficiency because of large number of tariffs

CPOs set per charge point a price for a charging session. This is done using a "Tariff ID" and a "Tariff" which can contain many different components. All these Tariffs are exchanged with their connected MSPs. Currently, this results in situations where a single MSP receives more than 130.000 different Tariffs (Tariff ID + Tariff information) from all their connected CPOs. As each CPO is sharing their tariffs with their MSPs, many millions of tariffs are exchanged, and none of the market parties are able to check and differentiate the valid tariffs from the non-valid tariffs.
The higher the number of tariffs, the bigger the risk that something goes wrong. Besides that it is not efficient.

- The biggest risk is that something goes wrong with synchronizing the tariffs between CPO and MSP
- If there are issues with tariffs, it is easier when there are no redundant tariffs.

A large part of these tariff sets contain exactly the same tariffs, but only have a different Tariff ID.

There are companies that use a different tariff ID per charge point or charge station, even when the same tariff is applied to another charge point.

- This can easily be improved by following internal procedures in companies (often CPOs) not to use different Tariff IDs for the same tariffs.

This is making tariff exchange needlessly inefficient because of the huge amount of redundant tariffs.

Many CPOs use 2 types of tariffs:

- Fixed tariff types, which are not specific for a specific location or customer. E.g. [ID: EURS050E035 - €0,50 start rate and €0,35/kWh] and [ID: EURS050E040 - €0,50 start rate and €0,40/kWh]. These tariffs cover most of their cases and can contain several components, although often limited to three.

- Custom tariff types, which are created for a specific location or customer and can contain many different components and variations. E.g. [ID: V21E073T0275 - €0,73/kWh and €0.275 after 90 minutes]

Recommendation:
Use Fixed tariff sets as much as possible and re-use them; don't use a separate tariff set with separate tariff ID for each charge point or station.

Issue with changing tariffs/variable tariffs at a station before charging

The market is moving more and more to flexible energy tariffs, different tariffs depending on certain delivered power or power limit effects, different tariffs as a result of smart charging, or different tariffs because of other events e.g. how busy it is at a certain charge location (location with several charge stations).

There are many reasons to do this e.g.:

- Flexible energy contract by the CPO can result in different prices for the MSP
- By different tariffs, EV drivers can be encouraged to charge at different times (i.e. used to try to change charging behavior).
- Different tariffs can be the result of different (max) delivered power at the station
- Etc.

Variable tariffs are used in the following situations:

- Peak- vs non peak tariff sets: based on fixed parameters (i.e. time between 4pm and 8pm) a peak price would be given. Currently there are two ways how companies deal with the situation when a session is part of a peak and off-peak time slot:
    - Sometimes the tariff is used during the whole session that was applicable when the charge session started.
    - Sometimes the tariff is changing during the session when peak/off-peak tariff is starting. In these situations, this must be clear to the EV driver before charging.
    - Sometimes an idle fee is added to a charging session, for example when the EV reached a certain % SoC. The impact of this on the total session costs can only be known when this situation occurs.
- Dynamic energy tariff sets based on actual energy costs (also called "spot pricing": This is used by the CPO or charge station owner in case of flexible energy contracts with day-ahead prices. In these situations the actual tariff can be different over time with a granularity in time of 15 minutes up to 24 hours. The dynamic energy prices can also be based on average energy cost. However CPOs often already know their price in advance (or are able to retrieve a price forecast of their retailer in advance). Often they don't communicate revised prices to MSPs in time.
- Dynamic parameter tariff sets based on CPO specific pricing policies: These are situations where the CPO changes the price because of a certain event. Currently there is no agreed time window when these tariffs are known, as a result it can be right before the start of a charging session. For example, in the case of:
    - Utilization dependent pricing: based on the forecasted charging demand at X time, CPO increases or decreases tariff
    - Prioritized pricing: based on actual 'reservations'

Although different tariffs at different moments are not making it more clear for the MSP as well as the EV driver, the current trend is not easy to change.

There are more and more situations that MSPs and EV drivers have to deal with a changing tariff right before charging. This is not desirable for both MSP and EV drivers.

The most flexible and unknown tariff is caused by flexible energy contracts that the CPO has with its utility. This tariff is known at least 12 hours before it is applicable (so called "Day Ahead tariffs) and

defined by the utility company based on among others expected demand and response of energy. Other tariffs might be based on this tariff.

There are also situations where the CPO-MSP tariffs and EV driver tariffs are based on actual changing situations e.g. the usage of chargers. In these situations the tariffs are known far before it happens. The only thing that is unknown is when this situation occurs.

Recommendations:

1. *The CPO must set the tariff changes for the MSP at latest 10* hours before it is applicable, so that the MSP has enough time to inform the EV driver, which should be at least 8* hours before it is applicable. This includes changes on the already known parameters by the MSP (time of use €/kWh, idle fee €/time, etc). Exemption: If dynamic tariffs are applied, it must be based on clear customer consent, and therefore activated between CPO and MSP, CPO is able to change tariff ad hoc. See also Recommendation 4.*
   (=these periods are based on information from the market what the latest moments can be that their own tariffs are known and that they can determine the tariffs for their partners: MSPs or EV drivers)*

2. *The CPO should inform the MSP about any other tariff mechanism which occurs based on real time insights (e.g dynamic fees based on utilisation or idle fees). The CPO has a certain freedom to apply for the following mechanisms, but is obliged to communicate this transparently to MSP and EV drivers: in time and in line with the previous recommendation.*

3. *For public charging and without explicit agreement between CPO, MSP and EV driver a CPO must not use energy spot pricing (= pricing based on actual energy cost at a certain moment) to MSPs and MSPs should not use energy spot pricing to EV drivers The goal of spot pricing is to push energy usage that is not time sensitive to off-peak hours, and implement load balancing on an international level. This works for utility contracts, under the assumption that smart appliances and charging stations can receive the spot pricing via an API, and plan their energy usage without human intervention. It is questionable if in situations of public charging people will change their travel plans based on spot prices of the day. The amount of tariff IDs will also explode as all tariffs need to be created and stored for auditing and historical reasons.*
   For private charging the situation can be different.

4. *Dynamic tariffs can be used if:*
   a. *It doesn't introduce too much complexity.*
   b. *It can be represented using the existing tariff restrictions.*
   c. *It is still relatively straightforward to communicate the kWh consumption rate for each time window of the day to the user.*
   d. *Users can still estimate the cost of their session before starting the charge*
   e. *It could easily be extended to include validity periods via start_date_time/end_date_time.*
   f. *A CPO transparently communicates in an electronic way via protocols to the MSPs, the parameters based on which dynamic tariff mechanisms will be activated.*
   g. *CPO and MSP have a contract in place to enable a MSP to activate dynamic models (i.e. opt-in for spot prices, opt-in for utilization based fees)*

   Example: peak and off-peak hours and tariffs (i.e. dynamic tariffs) that are known and can be sent by the CPO to the MSP at least 10 hours before it is applicable. See also recommendation 1.

5. *Every CPO is obliged to actively push a warning/notification to the connected market parties to make them aware of:*
   a. *price update*
   b. *time and day of enforcement*
   c. *affected price sets or - components (or IDs)*

Note:
Tariffs changing based on actual conditions can be hard or impossible to share with partners as current protocols do not support this.

Issue with changing tariffs but keeping same Tariff ID

A Tariff for a certain charge activity is not only used to know the tariff before charging, but also to verify the total costs after the charge session, if this is in line with the 'agreed' tariff before.

This means that a certain tariff ID should have the same tariff for a long period, for companies to be able to verify invoices. Currently there are CPOs that keep the same tariff ID, but change the tariff. This is creating all kinds of technical challenges: on the MSP side to keep historical data, and on the CPO side to prove a certain used tariff in the past.

It must always be clear for the MSP which tariff is valid at a certain moment.

Recommendation:
A Tariff (tariff ID + tariff) must not be changed once it has been published.

Issue with many tariff components in CPO-MSP tariffs

CPOs often create complex tariff sets, with up to 8 different tariff components (e.g. start fee, kWh fee, minute fee, etc.). All these components can get a certain value and become part of the charging costs. MSPs often base their EV driver tariffs on the tariffs and cost that they get billed by the CPO with a margin on it. When CPOs use many different tariff components, the MSP either:

- Forward this directly to their EV drivers which results in complex, hard or impossible to understand EV driver tariffs,
- Forward these complex tariffs to their EV drivers after simplifying and reducing them. The result will be that there is no direct relation anymore in the tariffs set by the CPO and the EV driver tariffs. If this is done by the CPO to change charging behavior this effect is totally gone.

Recommendation:

3. *A charging tariff should not contain more than 3 different components. Not between CPO and MSP and not for EV drivers.*
4. *The setup of tariffs by CPO to MSP should be used in the same way for MSP - EV driver tariffs. This does not mean that the MSP - EV driver model must be based on the CPO-MSP model, but the CPO-MSP model should not be so complex that it can't be used for EV driver tariffs.*

Protocol conformity

If tariffs change at a charge station, be sure a protocol is used that supports it to inform the other party beforehand. If you want to change a tariff at a charge station frequently (e.g. more than once a day) make sure you use a protocol that supports announcing the change before it is actually changing. (e.g. OCPI 2.2.1.)

Part 2: The relation between MSP/CPO and EV driver

MSP and CPO – EV driver

This part describes the relation with the EV drivers and how parties should approach them with their tariffs.

When a consumer buys a service or product he/she must:*
*(*This is according to consumer laws, e.g. European Price Indication Directive, regulations around unfair pricing and the different national implementations of it, same kind of rules exist in other areas in the world. Besides that it is also to what may be expected from a good consumer focussed market)*

- Be able to know and understand** the tariff before it is bought, and estimate the final cost.
- Be able to compare prices between different providers before the product or service is bought
- Being able to follow the cost during the process (i.e. session) and possibility to stop the process at any moment.
- And being able to verify the tariff after the product or service is bought.

*(** "Understand" means "the knowledge and ability to judge a particular situation or subject" source: https://www.britannica.com/dictionary/understanding)*

In the EV charging market, this is not always the case. Looking at all the complaints from consumers (EV drivers) it is even often not the case. Complaints about inaccurate or not understandable tariffs are tremendous*. This is not only an undesirable situation, but also against laws and regulations.
(*There are many consumer surveys and surveys from consumer oriented organization that show the issue with clear transparent pricing information)

Taking into account that this document is not limited for Europe, the European Alternative Fuel Observatory published a Consumer monitor in 2022. In the top 5 from important characteristics of a public recharging session for EU BEV drivers, 3 times pricing and payment is mentioned. See also: https://alternative-fuels-observatory.ec.europa.eu/system/files/documents/2023-06/2022%20EAFO_CountryReport_EU.pdf

This document first described the main different EV driver tariffs. Then the challenge of translating CPO-MSP tariffs into end use EV driver tariffs is explained. Followed by best scenarios that are described taking into account the different EV driver tariff possibilities.

Different EV driver tariffs

Towards EV drivers there are different types of tariffs and tariffs can contain different components. The main ones are explained in this chapter:

Ad hoc vs Subscription based charging and tariffs

- Ad hoc = a CPO only offer, without contract or subscription, using common direct payment methods like bank or credit card. .
- Subscription based charging = MSP subscription contract involved

In the European Union operators of public accessible charging stations are obliged to offer at least Ad Hoc access with a direct payment service. This can either be via QR codes and/or apps or websites. Or via physical payment terminal* (*In EU obliged for charge stations with 50kW or more.)

The tariffs and tariff components used for both systems can be similar, although using complex or dynamic prices via Ad Hoc charging, is very difficult taking into account the price transparency regulations, mentioned earlier.

Changing/Dynamic tariffs

These are tariffs that can change at a certain moment because of triggers as explained in the first part of this document: e.g. energy price, charge speed, moment of the day, etc.

Idle fees (fees not charging, but still connected)

These fees can apply during charging or only after charging. Often they are used to support that EV drivers move their vehicle, so the charger can be used by others again.

Other **charging tariff components**

There can be many other components in a charging tariff as also explained in part 1. This can be start fees, or priority charging fees, service fees, etc.

Different MSPs, different CPOs, different locations, different tariffs

Each CPO and each MSP respectively have their own tariffs and tariff structure either for Ad hoc charging or subscription based charging. This is often different per location, as it depends on all kind of agreements and costs for these parties like:

- Cost for energy of the chargers, which can be different per location and different per party depending on their energy contracts
- Cost as agreed in tenders: at public tenders, governments often set requirements for the cost of charger and charging services.
- MSPs often set their EV driver tariff based on the tariff they have to pay to the CPO, which can cause differences per location. This can result in different tariffs in the same area when different operators are active.

Challenge translating CPO - MSP tariffs in EV driver tariffs

The end user EV driver tariff is often based on the buying tariff from the MSP; what the MSP received and get invoiced from the CPO, with commercial margin added. As described in part 1 of this document the tariffs between CPO and MSP are often very complex and with smart charging and dynamic tariffs, this is getting more complex.

Complex tariffs and tariff structures between CPO and MSP generate huge challenges to translate them in understandable EV driver tariffs as the examples below show:

Location: Charger at an hotel in Europe

Max total tariff: 39 Euro ex VAT

Tariff:
Total price depends on the energy delivered and the connection time:
- From 8.00 AM util midnight: € 2,50 connection fee/start fee
+ € 0,60 per kWh
+ € 4 per half hour when charging is finished but still connected

- From midnight until 8.00 AM: € 1,50 connexion/start fee
+ €0,60 € per kWh
Cost continue as long as the vehicle is connected

24 hours a day - 7 days a week :
0.75000 EUR (rounded [N.Tn] to the nearest tenth) excl. taxes/15.00000 minutes (rounded [U.U] to the upper unit)
Limited to : 120 minutes
Beyond this limit :

- 0.83330 EUR (rounded [N.H] to the nearest hundredth) excl. taxes/15.00000 minutes (rounded [U.U] to the upper unit)
  Limited to : 60 minutes
  - 0.91670 EUR (rounded [N.H] to the nearest hundredth) excl. taxes/15.00000 minutes (rounded [U.U] to the upper unit)
    Limited to : 660 minutes
    - 8.33330 EUR (rounded [N.H] to the nearest hundredth) excl. taxes/1.00000 hours (rounded [U.U] to the upper unit)

24 hours a day - 7 days a week :
0.01083 EUR (rounded [N.H] to the nearest hundredth) excl. taxes/1.00000 minutes of charge, at a given average power level (see params in kW) (rounded [U.U] to the upper unit)
Parameters : > 1 , ≤ 4

And 0.02167 EUR (rounded [N.H] to the nearest hundredth) excl. taxes/1.00000 minutes of charge, at a given average power level (see params in kW) (rounded [U.U] to the upper unit)
Parameters : > 4 , ≤ 8

And 0.04333 EUR (rounded [N.H] to the nearest hundredth) excl. taxes/1.00000 minutes of charge, at a given average power level (see params in kW) (rounded [U.U] to the upper unit)
Parameters : > 8 , ≤ 15

And 0.06500 EUR (rounded [N.H] to the nearest hundredth) excl. taxes/1.00000 minutes of charge, at a given average power level (see params in kW) (rounded [U.U] to the upper unit)
Parameters : > 15 , ≤ 30

And 0.21667 EUR (rounded [L.H] to the lower hundredth) excl. taxes/1.00000 minutes of charge, at a given average power level (see params in kW) (rounded [U.U] to the upper unit)
Parameters : > 30 , ≤ 55

And 0.37500 EUR (rounded [L.H] to the lower hundredth) excl. taxes/1.00000 minutes of charge, at a given average power level (see params in kW) (rounded [U.U] to the upper unit)
Parameters : > 55

And 0.00000 EUR (rounded [N.H] to the nearest hundredth) excl. taxes/15.00000 minutes of connexion after charge is completed (rounded [U.U] to the upper unit)
Limited to : 15 minutes of connexion after charge is completed
Beyond this limit :

- 0.08333 EUR (rounded [N.H] to the nearest hundredth) excl. taxes/1.00000 minutes of connexion after charge is completed (rounded [U.U] to the upper unit)

Three different real world examples of CPO-MSP tariffs

It is possible that above examples of CPO-MSP tariffs are not created in such a way because the CPO wants it, but because of requirements from the charge station owner or via requirements in tenders. Nevertheless it may be clear that translating such tariff schemas into understandable end user EV driver tariffs, is extremely difficult or even impossible. Besides that these examples cannot be exchanged via existing protocols,

Complex CPO-MSP tariffs can result in high EV driver tariffs

The situation described in the previous paragraph often results in a situation that the MSP does not use it directly for their EV drivers. In many situations the MSP will create more clear and simple EV driver tariffs, that are relatively high as their own cost price is hard for a full session is hard to know before they receive the CDR.

Recommendation:
Very complex tariffs structures between CPO and MSP result often in more simplified, but relative high EV driver tariffs. This is not in the benefit of the end user, but also not the CPO or MSP. It is recommended to take that into account when defining tariff structures.
If the MSP is forwarding a complex CPO-MSP tariff, with or without margin, to the EV driver, it is recommended to add some warning by the MSP that the tariff structure might be hard to understand. This is already done in certain situations, and results in more simplified tariffs between CPO and MSP.

MSP/CPO - EV driver requirements

This part will describe the most common EV driver charging requirements and the impact of the tariffs on them. Each paragraph will end with recommendation, like was done in Part 1 of this document.

REQUIREMENT 1: Inform the driver in an understandable way the charging tariff before he/she starts charging and make sure total final cost can be estimated.

There are many ways to do this and it should not be complex.. Unfortunately it often goes wrong. A few ways to facilitate understandable tariffs:

- Make sure the driver can find the tariffs and knows where they can find it. There are many websites from MSPs and CPOs (for Ad Hoc charging) where the charging tariffs are hidden and difficult to find.
- Ensure that also in the mobile website or app the tariffs can be found
- The more tariff components are added the more difficult it is for an end user to estimate final cost - which is an obligation. Reduce the number of components.
- If a tariff is put on a plate close to the charge station, which can be very clear for the EV driver, realize that changing a tariff will require a change on the plate. Clear reference to a working mobile website with the rates might be more flexible and can also be very clear.
- Often QR codes are used for Ad Hoc charging, at least on AC charge stations. It happens that the link is not linked to a page with tariff information. If you use them make sure it is linking to a page with the tariff.
- It is often not clear if tariffs are including or excluding VAT. Although tariffs between CPO and MSP are normally sent excluding VAT, The Consumer tariffs must always include the VAT, which must be clearly stated.

Regulations and standards now require that the EV driver tariff is shown either at a display of the charge station (e.g. laws in California) or in the car to be compliant with the new standard ISO 15118-20. Because of that the MSP must send the EV driver tariff to the CPO, so that the CPO can forward it to the charger or vehicle. Of course the protocols must support this.

Recommendations:

- *Make sure EV driver tariffs can be found in an easy way, Preferable via the same medium as you do the payment. E.g. if payment is done via (dynamic) QR code, the tariff should also be visible on that page, if payment is done via app, also the tariffs should be visible via the app, etc.*
- *Reduce the number of components in EV driver tariffs (In Europe Ad Hoc charging tariffs are already limited to 3 components based on AFIR)*
- *If a time component is involved, make sure that this is clearly visible and understandable for the EV driver*
- *If there are multiple time components (charging/parking/idle time), it should be clear when exactly which time component is active.*
- *If an MSP applies CPO tariffs outside energy, the actual tariff should be shown and not for example a reference to CPO.*
- *Make sure that shown/visual EV driver tariffs can be changed*
- *Take into account the risks of using static QR codes*
- *Be clear about the VAT. Where the tariff is shown, the tariffs must include VAT and that must be mentioned clearly.*

Situation where own CPO - EV driver subscription tariff is different from other MSP - EV driver tariffs

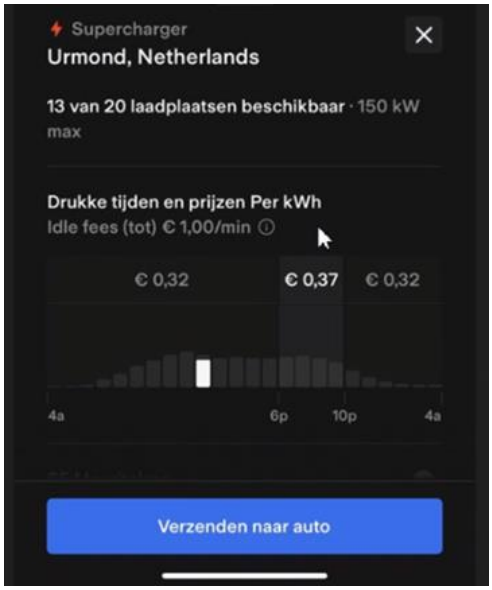
There are situations where the CPO also offers its own subscription based tariff. As there are no roaming cost involved, it can be lower than the EV driver tariffs from the MSPs they are connected to. It should be taken into account that there can be competition laws that prevent these kinds of differences in pricing.

Recommendation
Take into account regulations (e.g. competition laws) if you differentiate pricing between MSPs or between CPO Ad hoc tariff and the CPO MSP tariff, for the same service.

Situation with dynamic tariffs

Tariffs that change during the day become common practice. In part 1 this is already extensively described as it often is initiated by the CPO, regulator or charge point owner.
It is very important that the EV drivers are informed in a good way about this. In part 1 we already recommended to inform drivers at least 8 hours before the charge session about the tariff and reduce the changes in tariff during a session, unless there is an explicit agreement between CPO, MSP and EV driver to offer and use dynamic tariffs in a different way

A good example of how you can inform the EV driver in a clear way when dynamic tariffs are used can be seen in the picture.



REQUIREMENT 2: Support that drivers are able to compare prices between different MSPs and the CPO Ad hoc tariff before the product or service is bought.

In the EV market, there are many different terms used for the same 'thing'. E.g. "Price", "Tariff", "Cost" can all mean the same but can also mean different things depending on who is using it. Same for "Recharging station", "Charging Station", "EVSE", etc. For good comparison of tariffs/prices it is important to use the same terms. Some effort was done for this in the past, which showed that it is very hard to align this. Also because different terms are used by different standardization bodies.

Recommendation
To support comparison of EV driver tariffs, it is recommended that MSPs and CPOs:
- *Make very clear what they mean with used terms for tariffs and their components*
- *Use at least in their own communication to the EV driver everywhere the same terms*
- *Reduce complexity of tariffs, which would make it harder to compare*

REQUIREMENT 3: Make it possible that EV drivers are able to follow the cost during the process (i.e. session) and possibility to stop the process at any moment.

A charging session can take from several minutes up to many hours or even more. DC chargers have displays where the delivered kWhs are shown and if applicable the time the car is connected to this. When used with Ad hoc access and direct payment, it is possible that the total cost of the session can be followed during the session, via the display on the charger. However this is not yet the case in all situations.

Charging via an MSP requires that the CPO sends session information to the MSP or that the MSP can request the current session status. That way the MSP can show it to the EV driver via an app or messaging service. On a protocol level this is possible. Still many CPOs do not make use of the technical possibilities and also many MSPs do not implement and offer these possibilities to EV drivers.

When the progress during a session is shown, either via app or display, all tariff components that have influence on the final cost of the total session must be displayed.

Consumers must always have the possibility to stop a charging session during a session. This can either be via app, swipe of token or button on the charger.

It must be taken into account that when an EV driver activates the charge session via a physical token (e.g. card or keyfob), the driver normally can't see the session info unless his card is connected to an app/website and the person can check it in the app or on website.

Recommendation
If a charger has a display, make sure that at least progress of the different components (often kWhs and time) are shown. In case of Ad hoc access with direct payment, also the cost of the session should be shown during charging.
If an app or other messaging service is used the different tariff components must be visible including the progress of it during the session. This requires that CPO and MSP exchange session information in an electronic way.

Situation where time component is involved, which can result in high session cost

There are situations where a time component is used. This is often done in the following ways:

- From the beginning of the charge session, instead of kWh tariff (this is often done based on regulations that forbid kWh tariffs by non energy companies).
- When charging is finished but the car is still connected (this is often done to support that EV drivers remove their car so the charger can be used again by other person)
    - This is often called a "connection tariff"
    - Every municipality or CPO deals differently with it concerning the moment it starts, if it continues during the night, etc.

The total cost of a charging session can be extremely/unexpectedly high for the EV driver, because they are not informed well about these costs before but also during the session.

Recommendation
Inform the EV driver during the session about the status/cost. This can be easily be done by offering to set warnings via app or website when certain thresholds are reached. This can either be:

- *Charging is finished*
- *A certain total cost of the session is reached*
- *Every x minutes a warning or update.*

This is already very common for parking apps. In the EV market however this is not done yet, but highly recommended.

REQUIREMENT 4: Inform the driver immediately after the charge session about the cost of it, so that he/she can verify the cost of the transaction versus the tariff

Immediately after the EV driver finished the charge action, information about the cost of the charge session must be shared. This is mostly done via a CDR (Charge Detail Record). A CDR is both used for transaction information between CPO and MSP and between MSP and EV driver. Part of the CDR is not only the cost of the session, but also the amount of kWhs and/or time used. The MSP sets the EV driver tariff, which can be based on the tariff from the CPO. Because of that, the CPO must sent immediately after the transaction the CDR to the MSP, so that the MSP can inform the EV driver immediately after the transaction about consumed kWhs, time, other applicable components and the tariffs..

This information is not automatically the invoice and payment request. In situations where a subscription via an MSP is used, the invoice can be sent later including the payment request. This is often once per month. In the situation of Ad hoc access, the invoice will directly be made including the payment request.

In many countries there are obligations about the terms for sending an invoice. E.g. the Dutch Law demands you to send the invoice no later than the 15th of the month following the month of delivering goods or service. In the Dutch VAT law it is even mentioned that you must send an invoice within 5 working days after the month where product or service is delivered. In other countries similar obligations/regulations will exist.

Although there is no clear definition or timing what is meant with “immediate” for sending information about the charge action. However you must have the possibility to verify the information. Which means that you must receive it when you are still at the charge station to verify the kWhs via a display, and where you can still verify the right charge station and tariff on the CDR.

There are several ways to send CDRs. Most used ways are via mail or SMS or in the display of an app or website, or via terminal on the charger. This can be used for sending information about charge session cost for both Subscription based charging and Ad Hoc charging.

The different components used in the tariff must clearly be visible in the CDR. The EV driver must be able to verify the calculated cost with the tariff shown before the transaction. Each component should be clear and understandable in the tariff and not combined with other components. E.g. [tariff per kWh x kWh = X Euro/Dollar/Pound/etc] and [tariff per time unit x used time = X Euro/Dollar/Pound/etc.]

Tariffs for consumers must contain the applicable VAT. Also in CDRs the VAT must be very clearly mentioned.

There are a lot of issues with cross border charging (i.e. charging in a country where the MSP is not based) and how this must be dealt with in CDRs. Although there are some regulations and recommended ways of working for this, it should at least be clear to the EV driver on the CDR; whatever way of working is chosen.

<u>Recommendation</u>

- *Inform the EV driver as soon as possible when transaction is stopped about the cost of the session by sending a CDR (either by SMS, mail or showing it on display of charger or payment terminal.*
- *Create separate lines for different components on the CDR. Do not combine tariff components as that makes it impossible to verify it with the tariff before.*
- *CDR should include all the necessary elements for billing control by the EMSP*
- *Be clear about the VAT in the CDR.*
- *In case or cross border charging ensure that the used VAT rates (if any) are clear and on the invoice separate it by country where has been charged.*

Part 3: What should be taken into account in tenders and requests for proposals and regulations?

In part one and two the challenges with charging tariffs are explained between CPOs and MSPs and towards EV drivers. These challenges are described and recommendations are given how to deal with them.

However, the challenges are not always caused by the CPO or MSP. Sometimes in tenders and requests for proposals requirements are put that do not make it easy for the CPOs and MSPs to create clear understandable tariffs. There are also a lot of regulations that have an impact on the tariffs in positive and negative ways.

This part addresses the issues in tenders, requests for proposals and in regulations and gives recommendations how to deal with it.

Awareness - View from EV driver side

Charging stations are meant to be used to charge a vehicle to go from A to B.. This is done by persons who buy the energy for their vehicles. These are persons from different ages, from young to old and with different knowledge levels. However the charge infrastructure market is complex and there are a lot of challenges regarding available energy at certain moments and many other challenges. This results often in a situation that persons and organizations that define tenders and set regulations do not take care enough about EV drivers and if they understand the tariff, can find it easily and can verify it afterwards.

Recommendation

Take a view from the EV driver and imagine if any type of person can understand the requested tariff schema. This recommendation is not limited for persons active with tenders and regulations, but for everyone busy with EV driver tariffs.

Regulations / Requests in Tenders and Proposals

The situation in regulations and requests in tenders and proposals is mixed.
On one side stricter rules are set for better understandable tariffs. On the other side there are requests that result in misunderstandings and unclear tariffs and tariff schemas. Both are described with examples and followed by recommendations.

Stricter rules for better understandable tariffs

In all regulations regarding EV charging, clear understandable transparent pricing is required, although it is not always well defined what it means.
Good examples are limitations of the number of components in a tariff e.g. what the EU did in the AFIR regarding Ad Hoc tariffs: only three components are allowed.
It also helps to align the definition of time based tariffs that are meant to support that a vehicle is moved when charging is finished. These are also called idle, rotation or connection tariffs. The EU is now very clear that this can only start when charging has been finished. Although that still leaves room for interpretation, it is at least clear that it cannot be used during charging.
In several countries there is also the intention to set rules that during a charge session the tariff cannot be raised anymore only be lowered compared to the tariff at the moment of charging. Although it reduces energy flexibility it is very clear to the end user that they will never pay more than the tariff known before.

Recommendation

Limiting the amount of components is one way to reduce complexity.
Clear definitions of possible used components are very helpful e.g. idle fee (time when charging is finished but car is still connected and uses a charge parking spot)

Regulations about flexibility of tariffs during a session make tariffs more understandable and easier to verify at the end, e.g. max amount of different tariffs or that a tariff cannot be raised during the session.

Setting max EV driver tariffs

There are situations, often in tenders, where a max EV driver tariff is set with max yearly raise. Although this looks end user friendly several things should be taken into account:

- The CPO who normally applies for the tender, only has influence on their Ad Hoc EV driver tariff and the CPO-MSP tariff. They have no influence on the MSP-EV driver tariff.
- Setting a max EV driver tariff might result in issues for the CPO when at a certain moment the cost for the CPO raises e.g. extreme raise energy cost.
- It can result in extreme tariff differences on local level, if in an area several tenders are issued at different moments with different tariff requirements. Alignment in these situations might be more clear and understandable for the EV driver.

Recommendation

Be careful by demanding max EV driver tariffs. It can result in undesired situations e.g. when because of unexpected circumstances the cost of the CPO raises. Take into account that the CPO is only responsible for the Ad Hoc EV driver tariff and is never responsible for the MSP-EV driver tariffs, although of course their CPO-MSP tariff has influence on that.

Requirements resulting in unclear tariffs and misunderstanding regarding tariff setting

There are situations where the requirements in tenders result in misunderstandings for implementations or for the end user. A few examples:

- Tariffs based on max power that a charge point can deliver.
    - It is not always clear what the max power is that a charge point can deliver. Especially when there are several charge points at a charge station with different power levels, it must be very clear what the max power is for a specific charge point.
- Tariff based on max delivered power during a session.
    - In a large EU city there are public charge stations with tariffs based on max delivered power during a session.

Recommendation

Using tariffs based on max power, either from a charge point or delivered during a session is extremely difficult to implement, create understandable EV driver tariffs and create a situation that the CDR and invoice can be verified after the transaction. Because of that it is strongly recommended NOT to use max power as bases for tariffs.

Requirements for Smart Charging with flexible tariffs and power

Smart charging is becoming more and more common. This has two main components:

- Flexible availability of power - this can change during a charging session
- Flexible tariffs that support use of flexible power, or discourage non usage of flexible power.

Cost of charging is related to what the EV driver gets for it. With Smart Charging this relation is often less clear, the tariff is known, but what the EV driver gets for it can change. In other parts of this document we already described that there are possibilities to implement Smart Charging and dynamic power, if the right guidelines are followed. Important part is that the EV driver knows before charging the tariff and the expected power. And that they have an option to opt-out or opt-in - this can depend on the situation.

Recommendation
When Smart Charging is required in tenders or by regulations, it is recommended to take into account that the CPO (for Ad Hoc) and MSP must be able in a clear understandable way to inform the driver before charging and that they can verify it afterwards. Tariffs and power that can change several times during a session are not supporting that and should either be limited or totally prevented. E.g. the start of a peak hour with changing tariff and power can perfectly be communicated before charging and can easily be verified after charging. Changing power and tariff four times an hour is almost impossible to be informed before and be able to verify it afterwards.

It should also be taken into account that there will be much more acceptance for Smart Charging and dynamic power, when it is clear for the EV driver that he/she is not only punished when not using or accepting it, but also gets benefits when they accept it.

Connection tariffs / idle tariffs / rotation tariffs / occupancy fees (different terms, but all used for purpose to move a vehicle when power transfer of a charging session has finished)

Municipalities often want to support that electric vehicles are moved away from a charge station when charging is finished. Because of that they require a time based tariff after charging. The current situation is that it is a total mess what these tariffs are and when they apply. Different areas/streets in same place can have different ways of how these tariffs are implemented. The main issues:

- Unclear how to know when a vehicle is finished charging; it can also be on pause because of smart charging, and there is not a parameter in protocols that state that charging is finished (except when the drivers ends the session).
- Unclear when these tariffs start? Sometimes x period after charging, sometimes not during the night which can have different start and end times, etc
- Not taken into account is that car sharing vehicles that do not have own reserved charge points, have big issues with time based tariffs. When the car sharing driver is finished using the vehicle and connects it to a charger, the cost is for the car sharing company. With time based tariffs this can become huge amounts.

Recommendation
- Time base tariffs meant to move the vehicle when active charging is finished should only be used after charging (100 % State of Charge or to the self set limit) and not during charging. In the EU this is already part of the AFIR and that way in all EU countries the only allowed way to use them.
- Municipalities should ensure that these time based tariffs are very clear for the EV driver when they start and stop and if during which period in the night it is not applicable.
- Municipalities should ensure that there are no or very limited different ways it is used in areas of their city.
- When there are car sharing companies active in a city that do not have reserved charging points, it should be offered that time base tariffs do not apply for these vehicles.
- It must be very clear to the EV driver how the municipality and operator decide when the vehicle is finished charging.

Signage and price poles

Many municipalities have regulations about signage for charging infrastructure. Although it is not always clear if it is exclusive for electric vehicles and that other vehicles could get fines or could even be removed.

Although a price pole for AC charges might not be the most practical thing to add, for DC chargers it is very well possible. It is strange that in most countries price poles are an obligation for fuel stations to display the Ad Hoc tariffs for the different fuel types, but for charge stations this is not yet managed. Especially for Ad Hoc prices at DC charge station locations at fuel stations, it can easily be added on price poles and it would be logic to demand this clear digital visibility before the driver arrives, eg. along the highways. Enclosed some good examples:

Recommendation

Good signage and price poles can be very helpful for the EV driver, if they are used in the right way. That can be enforced via the tenders and in regulations:

- Clear signage at the location of a charge station should state that it is exclusive for charging electric vehicles and that electric vehicles that are not charging or connected are not allowed to use that place neither other non electric vehicles. Statement that these vehicles can get a fine or be removed is recommended to add on the signage.
- Price poles should be required for at least the DC charge stations along the highways, showing the Ad hoc tariffs for the different max power levels.

Part 4: Future trends and developments

This White Paper about Tariffs in the EV charging world, describes many cases in the EV charging chain that have an impact on tariffs, CDRs, invoices and correct and clear information towards the EV driver. We realize that there might be cases in the future that are not covered in this document. E.g.

- How to deal with tariffs in a V2G situation
- How to deal with tariff information in Plug and Charge situations

It is also possible that future developments have an impact on current described cases. E.g because of new regulations, or different views on how to deal with (dynamic) tariffs for Smart Charging.

These developments and changes will be taken into account in updates of this document.

Pricing transparency remains key for the short term and long term. The EVRoaming Foundation together with the EV industry and regulators will continue to put effort in clear transparent tariffs, invoices and the expected and delivered power for EV drivers.

ANNEX 1 Tariff complexity explained

Complex tariffs are not always complex just because they have a lot of components. Also tariffs with a few components can be complex. This Annex 1 explains how and why a tariff can become complex, the pros and cons and alternatives. The examples are purely for informational purposes.

Base tariffs

The three dimensions that can be invoiced are

1. Flat price per session
2. Time (from the start of the session until the cable is disconnected)
3. Energy (kWh)

The most basic tariff structure that is widely supported only uses these components, without further restrictions.

Examples

The most basic tariff:

- `€ 0.50/kWh`

`If you want to encourage users not to keep the charging point occupied without charging, you can add a time-based tariff. You can lower the kWh tariff, so that the expected cost while charging at 22kW is still € 0.50/kWh.`

- `€ 0.27/kWh + € 5.00/h`

In some countries you're only allowed to charge for energy if the device has a certified meter. You may be forced to use a time-based tariff.

- `€ 10.00/h`

Benefits

Almost all MSPs will support these tariffs, and they are very clear and easy to communicate to the user.

Risks

It's still possible that an MSP uses a fixed tariff on all charging points, and ignores the CPO tariffs. Time-based tariffs can cause very expensive sessions if users don't realize it's time-based. Devices with hardware problems that don't properly terminate a session can result in sessions of multiple days.

Threshold tariffs

If you want to make a certain amount of energy or the first few hours cheaper, you can add threshold restrictions.

Examples

You can make the first 10 kWh cheaper:

- `€ 0.25/kWh for the first 10 kWh, € 0.50/kWh after that`

You can add a time-based tariff after some time, to discourage users from occupying the charging point longer than necessary, or charge to 100%.

- `€ 0.50/kWh + € 10.00/h after 3 hours`

Benefits

This is an easy way to differentiate your pricing based on energy usage or duration, and is not difficult to communicate. Users can perfectly predict what the price of a session will be, and at which exact moment they have to return to the charging point to avoid extra costs.

Risks
MSPs that don't support thresholds will probably charge the most expensive price from the start of the session.

Alternatives
You can charge the threshold component from the start of the session and lower the other components. The resulting total price will often be very similar, and the tariff will be less complex.

Tariff schedules

If you want to increase the price during peak hours, you can set different prices depending on the day or time.

Examples
You can set a different price during working hours:

- `€ 0.50/kWh from Monday to Friday between 9:00 and 18:00, € 0.30/kWh otherwise`

Or add an extra component:

- `€ 0.30/kWh + € 5/h between 9:00 and 18:00`

Benefits
You can optimize your profit by following the demand.

Risks
These tariffs are more complicated to communicate in a clear way, especially if there are multiple components with different schedules. The MSP will have to show the full schedule.
MSPs that don't support this, will probably charge the most expensive price at all times.
It should be made clear to the user that the price can change during the session.

Alternatives
If you calculate the mean price based on expected usage, you can always use this price. The expected profit will be the same, and the tariffs will be less complex.

Idle tariffs

(sometimes called "connection tariffs" or "rotation tariffs")

The most naive way to discourage users from occupying a charging point, is by charging for the time they're not charging.
There are multiple ways to define "not charging". It can be based on status notifications from the device (assuming they always arrive reliably), or based on average energy consumption during a given period (assuming the device regularly and reliably sends meter values).

Examples

- `€ 0.50/kWh + € 5/h when not charging`
- `€ 0.50/kWh + € 5/h if less than 100 Wh is consumed for 5 minutes`

Benefits
Occupying a charging point without charging is discouraged, under the assumption that the MSP will actually charge the idle tariff to the user.

Risks
If you want to invoice based on the charging status, you have to be sure the status information is reliable and clearly defined. It should be clear whether a session can have multiple idle periods.
The user should be able to verify the price calculation, so the MSP should communicate the exact charging periods on the invoice, and explain how the charging status is determined.
Since the meaning of idle tariffs can be different for each CPO, it's difficult for an MSP to support it while being compliant with consumer rights legislation. MSPs that don't support idle tariffs might charge the idle tariff from the start of the session.
Idle tariffs can easily be defeated by the user by limiting the power consumption of the car, and therefore prolonging the session.
It can be difficult for the user to predict the price, since it's unpredictable when the battery will be full. Charging speed can be affected by external factors (temperature, load balancing, …).
Idle tariffs don't discourage charging to 100%, which will become slow when the battery is almost full.

Alternatives
If the goal is to discourage occupying charging points longer than necessary, it's essential that the user is actually charged the idle tariff and understands it. Threshold tariffs can accomplish the same, with a higher chance of success and in a more user-friendly way.

Combination tariffs

You can combine different kinds of restrictions.

Examples
Combination of threshold and idle tariff:
- `€ 0.50/kWh + € 5/h after not charging for 30 minutes`

Combination of schedule and idle tariff:
- `€ 0.50/kWh + € 10/h when not charging between 9:00 and 18:00`

Benefits
The possibilities are endless.

Risks
You can create very complex tariffs this way, but the chance that MSPs will support this tariff and charge it to the user becomes very low.
Alternatives
Think about what you want to achieve, and whether it can be done with a less complex tariff. Are all the restrictions really necessary?

ANNEX 2 Proposed standardized way how CPOs and MSPs can deal with tariffs in a technical way – based on Tariff module from OCPI v.2.2.1

Proposal 1: use restrictions only when the price changes

OCPI gives us many ways to represent the same price, let's take an example:

Let's say we want charging costs to be 0.50E/kWh.

We can express this by simply defining a single segment containing a single energy component:

```
{
 "id": "my-tariff",
 "segments": [{
    "price_components": [{"type": "ENERGY", "price": 0.50, "step_size": 1000}]
 }]
}
```

But we can also express it by defining 7 segments with dayOfWeek restriction each containing a single energy component

```
{
 "id": "my-tariff",
 "segments": [
  {
   "price_components": [{"type": "ENERGY", "price": 0.50, "step_size": 1000}],
   "restrictions": {"day_of_week": [ "MONDAY" ]}
  },
  ...,
  {
   "price_components": [{"type": "ENERGY", "price": 0.50, "step_size": 1000}],
   "restrictions": {"day_of_week": [ "SUNDAY" ]}
  }
 ]
}
```

Or we can do multiple segments using the start_time / end_time restrictions

```
{
 "id": "my-tariff",
 "segments": [
  {
   "price_components": [{"type": "ENERGY", "price": 0.50, "step_size": 1000}],
   "restrictions": {"start_time": "00:00", "end_time": "12:00"}
  },
  {
   "price_components": [{"type": "ENERGY", "price": 0.50, "step_size": 1000}],
   "restrictions": {"start_time": "12:00", "end_time": "00:00"}
  }
 ]
}
```

There are many more ways to represent the same price and they all come from abusing the segment's restrictions.

Most platforms are able to understand and process all these different implementations, but what do we show to the EV drivers?

1. 0.5€/kWh
2. 0.5€/kWh on Monday, 0.5€/kWh on Tuesday, …, 0.5€/kWh on Sunday
3. 0.5€/kWh between 00:00 and 12:00, 0.5€/kWh between 12:00 and 00:00

They all mean the same thing, number one makes sense, the others probably don't.

A way to solve this problem is to use restrictions only when they are needed.
In the examples above they are not needed because the price doesn't change from one segment to the other.

Example of a correct usage of restrictions according to the proposal

```
{
 "id": "my-tariff",
 "segments": [
  {
   "price_components": [{"type": "ENERGY", "price": 0.50, "step_size": 1000}],
   "restrictions": {"start_time": "00:00", "end_time": "12:00"}
  },
  {
   "price_components": [{"type": "ENERGY", "price": 0.60, "step_size": 1000}],
   "restrictions": {"start_time": "12:00", "end_time": "00:00"}
  }
 ]
}
```

Example of an incorrect usage of restrictions according to the proposal

```
{
 "id": "my-tariff",
 "segments": [
  {
   "price_components": [{"type": "ENERGY", "price": 0.50, "step_size": 1000}],
   "restrictions": {"start_time": "00:00", "end_time": "12:00"}
  },
  {
   "price_components": [{"type": "ENERGY", "price": 0.50, "step_size": 1000}],
   "restrictions": {"start_time": "12:00", "end_time": "00:00"}
  }
 ]
}
```

The tariff above should be represented this way instead

```
{
 "id": "my-tariff",
 "segments": [
  {
    "price_components": [{"type": "ENERGY", "price": 0.50, "step_size": 1000}]
  }
}
```

Proposal 2: send the same tariff only once

EMSPs receive and need to manage an increasingly high number of tariffs, as discussed in previous meetings, some of them already need to handle more than 100.000 tariffs.
Most of those tariffs are just duplicates, but they have different ids so they need to be managed.

This is not only a waste from the data transfer point of view but it becomes a synchronisation problem as well.

A tariff needs to reach the EMSP before that tariff is attached to a connector, in OCPI terms, the tariff PUSH needs to happen before the connector PATCH:

```
PUT /tariffs/AA/BBB/my-tariff
{
 "id": "my-tariff",
 "segments": [{
    "price_components": [{"type": "ENERGY", "price": 0.50, "step_size": 1000}]
 }]
}
```

```
PATCH /locations/AA/BBB/my-location/my-evse/my-connector
{
   "tariff_id": "my-tariff"
}
```

This way the EMSP can make sure it will show the right price to their customers.

If a new tariff is created every time a price is changed, the synchronisation above is required.

Systems are not perfect unfortunately, so any of the following can happen:

- A tariff might be pushed (way) after it is attached to the connector via a PATCH
- A tariff might not be pushed at all
- A tariff might not reach the EMSP (because the EMSP system is down or because the EMSP is rejecting it)

What should happen when a tariff is not delivered in time? This is a question for another proposal maybe, but what can we do to reduce this risk?

In a perfect world, the CPO knows all the tariffs it will ever want to use and pushes them to the EMSP (or the EMSP pulls them) at handshake time. After that the tariff module is not really needed anymore, the CPO just needs to send connector PATCHes to change tariffId using one of the ids it already communicated to the EMSP.

But this perfect world doesn't exist, is there still something we can do?
Yes! Reduce the need to push new tariffs (hence reduce the risk of having non synchronised tariffs).

Example:
Let's say a CPO has two tariffs in total:

```
{
 "id": "30-cent-kwh",
 "segments": [{
    "price_components": [{"type": "ENERGY", "price": 0.30, "step_size": 1000}]
 }]
}
```

```
{
 "id": "60-cent-kwh",
 "segments": [{
    "price_components": [{"type": "ENERGY", "price": 0.60, "step_size": 1000}]
 }]
}
```

The EMP will first pull the tariffs after handshake and then pull locations.
Each connector has either tariffId=30-cent-kwh or tariffId=60-cent-kwh.

After some months, the CPO wants to change its prices:

- 30-cent-kwh should become 60-cent-kwh
- 60-cent-kwh should become 90-cent-kwh

Now, the EMP already has 60-cent-kwh, so there is no need to push it again, as there is no need to create a new tariff with the same content but different id.

To change price from 30-cent-kwh to 60-cent-kwh all the CPO needs to do is

```
PATCH /locations/AA/BBB/...
{
   "tariff_id": "60-cent-kwh"
}
```

For each connector that previously had tariffId=30-cent-kwh

To change price from 60-cent-kwh to 90-cent-kwh a synchronisation is required because the EMP doesn't know, yet, the 90-cent-kwh exists. In this case the CPO should:

PUT /tariffs/AA/BBB/90-cent-kwh

```
{
 "id": "90-cent-kwh",
 "segments": [{
    "price_components": [{"type": "ENERGY", "price": 0.90, "step_size": 1000}]
 }]
}
```

And then, for each connector that previously had tariffId=60-cent-kwh

PATCH /locations/AA/BBB/...

```
{
   "tariff_id": "90-cent-kwh"
}
```

If the CPO now wanted to revert the price change back to 30-cent-kwh and 60-cent-kwh it wouldn't need the tariff module anymore, because the EMP already has those two tariffs:

PATCH /locations/AA/BBB/...

```
{
   "tariff_id": "30-cent-kwh"
}
```

For each connector that previously had tariffId=60-cent-kwh

PATCH /locations/AA/BBB/...

```
{
   "tariff_id": "60-cent-kwh"
}
```

For each connector that previously had tariffId=90-cent-kwh.

Bottomline, the CPO should send as many tariffs as different prices they have, this means:

- Only one tariff (and tariffId) saying 30 cent per kWh
- Only one tariff (and tariffId) saying 60 cent per kWh
- …

Proposal 3: do not change already communicated tariffs

OCPI's tariff module allows updating/deleting already communicated prices via the PATCH/DELETE endpoints.

This behaviour introduces a number of challenges:

- Should the new tariff be valid from now? What about charging sessions that were already ongoing when the tariff update came?
- How can the tariff updates be traced? The id is always the same but the content is different.
- What does it mean to DELETE a tariff?

In the spirit of keeping things simple, the CPO could communicate tariff changes as shown in Proposal 2:

1. Create a new tariff when a new one is needed (i.e. a tariff contents never communicated before)
2. PATCH the relevant connectors setting the new tariffId.

This way every tariff change is traceable by looking at the connector PATCHes and each tariff is immutable, meaning a tariff with id 90-cent-kwh always means the same thing.

It will also render tariff PATCH and DELETE useless, simplifying the tariff module implementations.

Tariff Module Common Mistakes

The last_updated field in the location module should be … updated
When a location component (location > evse > connector) is updated, its last_updated field and the last_updated field of all its parents should be updated.

For example: if the status on an evse is updated then:
- evse.last_updated should be updated
- location.last_updated should be updated

Another example: if the tariff_id of a connector is updated then:
- connector.last_updated should be updated
- evse.last_updated should be updated
- location.last_updated should be updated

Basically, everytime a location is updated, independently from the level (connector/evese/location), its last_updated field should be updated.
This is important to make the delta pulls on the location module work properly!

What's delta pull?
OCPI allows getting locations specifying a date_from parameter to avoid downloading the whole locations database from the CPO every time:

GET /locations?date_from=2023-04-01T00:00:00Z

This means: give me all locations having last_updated >= 2023-04-01T00:00:00Z

Why is this a problem? Updates are pushed anyways
Yes and pushing updates should cover most of the cases, but sometimes an update is not pushed or is not received.
So pulling locations as described above, allows the systems to become more resilient.

Suppose that:
- connector.tariff_id is updated today (2023-04-01 at 12:00)
- the related location.last_updated is NOT updated and stays 2023-03-15
- the connector PATCH (updating about the new tariff_id) doesn't reach the EMP (for whatever reason)

When the EMP does a delta pull:

GET /locations?date_from=2023-04-01T00:00:00Z
It will not receive the location updated with the new connector.tariff_id hence it will not know that the price has changed on that specific connector.

Prices are always excluding VAT
Prices communicated via the OCPI tariff module should always be considered excluding VAT.