32nd Electric Vehicle Symposium (EVS32)
Lyon, France, May 19 - 22, 2019

Electric Vehicle Charge in collective housing

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Summary

The development of electrical vehicles for private individuals is a major concern for the climate change and healthcare of the large cities inhabitants. The French potential of electrical vehicles charge is estimated at 7 millions of charge points by 2030, mainly 7 kVA and up to 350 kVA for quick charges. Home charging accounts for 90% of EV refills and 44% of French people live in collective housing. So, EVs charge solutions for collective housing are a key success factor for the development of electric vehicles.

Enedis [2] Enedis, https://www.enedis.fr/english is the French DSO which operates 95% of the distribution grid in France and aims to co-build solutions for the large-scale development of electric mobility. In particular, Enedis is committed to support condominiums and house landlords for the design of their collective EVs charge solution.

The main stake in collective housing is how to design an upgradeable and adaptive solution that can supply the first demands but taking into account the future needs in order to facilitate the deployment of EVs.

Several configurations can be implemented:

- Connection to the personal electric installation of the apartment: this solution is not recommended.
- Connection to the common services. This solution is easy to install but can be quickly limited by the power capacity and needs energy metering to allocate the consumption of the EV charge points.
- Creation of a specific delivery point, connected to the existing electric feeder of the building or directly connected to the grid, and which supplies several EVs charge points equipped with private meters to ensure the energy division between the users. This solution allows a collective smart charging but obliges the condominium to operate the allocation of the energy consumptions or to delegate this service to a mobility operator.
- Creation of a collective wire, connected by the DSO to the existing electric feeder of the building or directly to the grid, and which supplies delivery point in each garage box equipped with an individual smart meter. This solution allows each user to choose his own energy supplier or mobility operator.

Among all these solutions, Enedis is involved and aims to support and facilitate the power supply by providing practical advice, and carrying out the requested works to deliver power to the EV charge installation.

1. Introduction

The transportation sector accounts for 38 percent of French greenhouse gas emissions in 2015 [3] French Government, http://www.statistiques.developpement-durable.gouv.fr/lessentiel/ar/199/1080/emissions-gaz-effet-serre-secteur-france.html, 2015 statisticsSwitching to sustainable modes of transportation has become crucial to preserve the future of our planet. In addition, the noise and air pollution generated by road transport raise public health issues. In the territories, public authorities promote and support the transition to sustainable mobility, respectful of the citizens'environment. Particularly, the main stakes of the electric mobility are:

- Reduction of greenhouse effect gas emissions;
- Improvement of the air quality;
- Reduction of noise pollution;
- Supporting the change of behaviours and public needs such as car sharing.

These challenges are even greater in metropolitan areas and large cities that concentrate the major part of the population and car traffic.

Today, 44% of French people live in collective housing [4] INSEE, https://www.insee.fr/fr/statistiques/2533533, 2015 statistics , and this rate reaches 90% in metropolis. 90 to 95% of EV refills at home [5] France Stratégie, Webconférence - Quelle place pour la voiture électrique dans la mobilité de demain ?, 2018-12, EVs charging in collective housing is now becoming a major challenge to facilitate the deployment of electric vehicles.

1 "*Plug act*" and collective infrastructure

Since 2014, the regulatory framework offers a "*plug act*" that gives the right to have an EV charger for every co-owners and tenants in a collective housing. Despite this, access to a charging infrastructure remains complex. Indeed, the co-owner must request the approval of the condominium assembly to connect his EV charge point to the common electric supply or to create a new delivery point.

Getting an easy access to a charge point at home is the major issue for purchasing of electric vehicles.

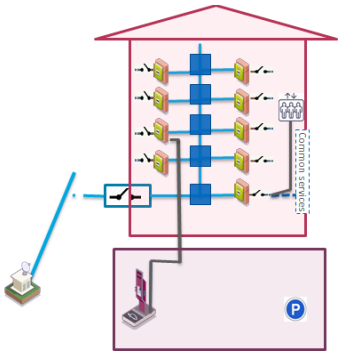
The French act "*Loi d'Orientation des Mobilités*" [7] aims to enhance this ability for a resident to get his EV charge point by facilitating the process of decision of the condominium assembly which will reduce the timeframe.

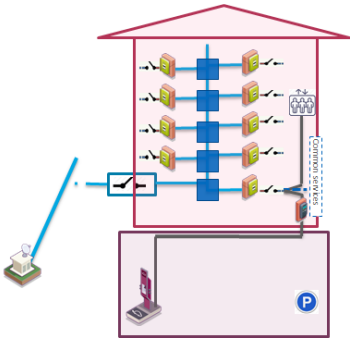
The first EV charge point requests can be completed by connecting to the personal electric installation of the apartment connecting or to the power supply of the buildings' common areas.

But the connection to the personal electric installation is not recommended [9] because the cable leading from the apartment to the parking lot must be isolated from all other electric cables and easily shut down in case of emergency. This configuration can suit to very small condominiums.

Fig1 : not recommended

Fig 2 : connection to the common services





delivery point connected to the grid by a smart meter

private meter for energy allocation

But the main stake in collective housing is to anticipate how to charge more than few EVs, so how to build an upgradeable installation that can deliver supply as needed taking into account that the development of EV is done step by step and is about to reach 15% up to 30% at 2030 ….

In addition, as each co-owner has a dedicated parking lot, another question is how to deliver an EV charge point to the desired parking lot or garage box.

This is why Enedis is committed to support the design of solutions for collective EV charge solutions in cooperation with all the stakeholders (EV manufacturers, infrastructures manufacturers, co-ownership trustees, lessors, co-owners, real estate managers).

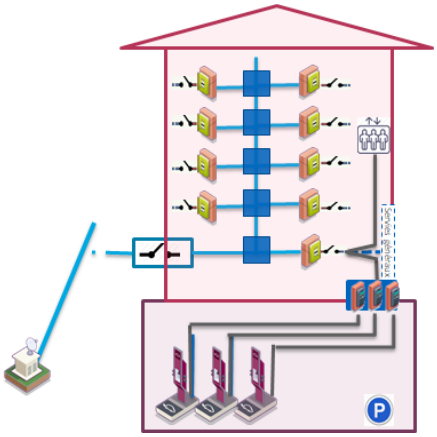
Indeed, this collective infrastructure approach will lead to a more efficient and standardized plan in the long term.

2 Configurations for EVs charge collective infrastructure

2.1 Collective infrastructure for underground car parks

As the collective infrastructure has to be preferred, there are several configurations to provide a secure, progressive, and efficient solution:

- Connection to the common services, if the power capacity is available : the condominium installs an electric dispatching box on which the users connect their electric supply for the EV charge point of their parking lot. The condominium manager ensures the operation and allocates of the energy consumptions or, the condominium delegates that activity to an electric mobility operator which carries out the connections of each parking lot on demand, and manages metering and billing.



This solution is easy to install but is not adaptive and upgradeable. Moreover, the cost for the end user depends on the location of his parking lot and the distance of the cable between the dispatching box to his EV charge point.

- Creation of a specific delivery point to supply the EV charge points : the condominium finances and manages a sufficiently well-sized delivery point to allow to supply later all other co-owners. The condominium manager ensures the operation and allocates of the energy consumptions or, the condominium delegates that activity to an electric mobility operator which carries out the connections of each parking lot on demand, and manages metering and billing.

The delivery point can be connected to the existing electric feeder of the building (Figure 1) or directly to the grid (Figure 2).

Figure 1: connection to the existing electric feeder

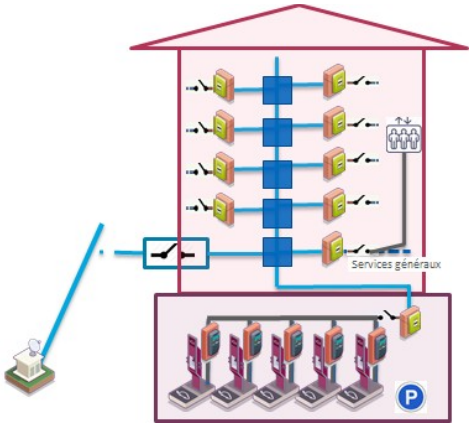
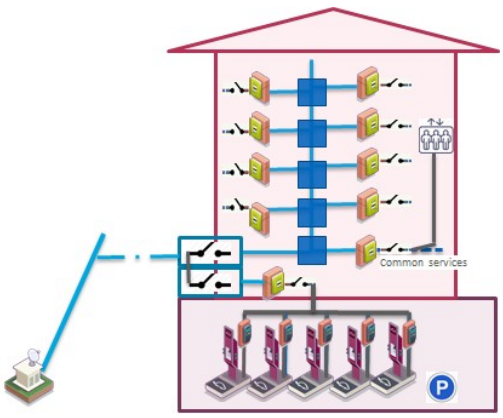


Figure 2 : connection to the grid



This solution allows management of the collective smart charging but needs to have a common EV charge service supplier for all the co-owners. As a consequence, the co-owners are not able to choose their own supplier.

- Creation of a distribution electric feeder by the DSO : the condominium asks the DSO to create a collective wire in the parking connected to the grid, to supply each parking lot with an individual smart

meter. This solution allows each co-owner to choose his own energy supplier. The maintenance of the collective infrastructure is done by the DSO.

Figure 1:

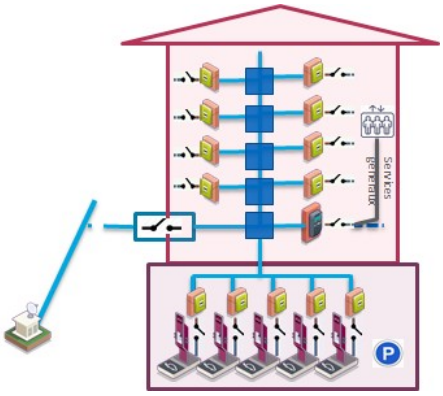
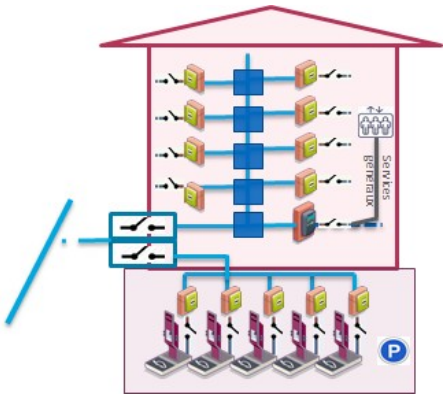
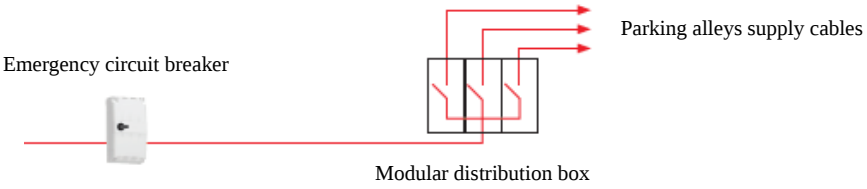


Figure 2:



The collective infrastructure has a charging cut-off device. This device is dedicated to firefighters to switch off the electrical power supply of the car park.
Then, the Modular distribution box ensures the dispatching of the collective wires to supply the driveways.



The collective wires must be laid on cable trays that do not degrade on fire and located at the top of lateral walls or at the ceiling.
The derivations of each delivery points are connected with insulation piercing connectors to the main wire and are equipped by a smart meter and an individual breaker.

Insulation piercing connector

2.2 Collective infrastructure for outside car parks

In addition to the previous frames that can be applied also to outside car parks, another solution is to create a new connection to the grid to supply one single delivery point (Figure 1) or an electric feeder which supplies delivery points for each EV charge point.

Figure 1 : connection of a new delivery point to the grid

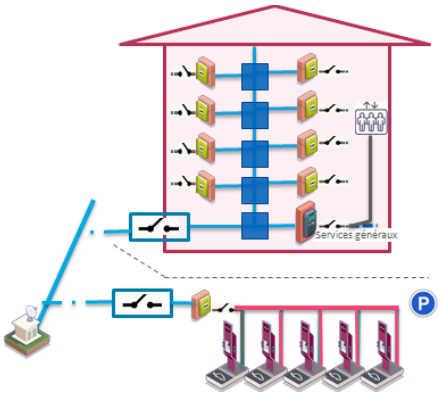
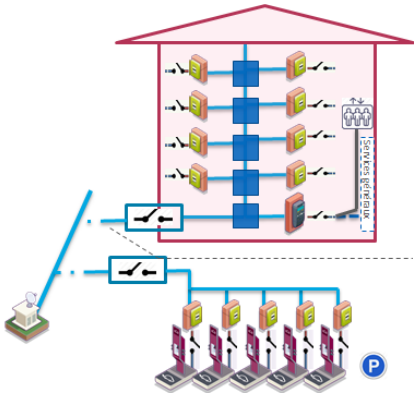


Figure 2 : distribution electric feeder



In that case, the collective infrastructure is an underground cable which supplies the parking lot dedicated to the EV charge point if the parking lots are shared and not allocated.

This configuration is particularly adapted to EV car sharing solutions and this is the opportunity to have open access EV charge point to provide in and off house EV charge solution.

3 Infrastructure sizing

In these collective solutions, the design must take into account [11] :

- a demand factor that corresponds to the average of the charge load on the collective infrastructure
- a power supply booking ratio that corresponds to an estimated impact on the distribution grid of the EVs charge.

Collective infrastructure sizing:

$$P_{collective\ infrastructrure} = N \times P_{dc} \times D_f \quad (1)$$

Distribution grid connection sizing :

$$P_{grid\ connection} = N \times A \times P_{dc} \times D_f \quad (2)$$

- $P_{collective\ infrastructure}$ Power capacity of the collective infrastructure
- $P_{grid\ connection}$ Power capacity of the connection of the collective infrastructure to the grid
- N Number of parking place
- P_{dc} Power capacity of each charging point = 7,4kVA
- D_f Demand factor = 0,4: all EV are not connected at the same time
- A Minimum power supply booking ratio = 20%;

Nota : the regulatory framework [8] sets the minimum power supply booking ratio for EVs charge at 20% in existing and new buildings but the condominium can decide to choose more than this value if the EVs charge needs of the co-owners exceed this value.

Nevertheless, a smart energy management system can avoid to make a strengthening of the collective infrastructure.

But anyhow, when the number of electrical vehicles becomes important, it is essential to monitor and control the load to limit peak curve issues and prevent all EVs to be recharged simultaneously and as a consequence, lead to a possible overload of the electrical installation.

4 Conclusion

Connecting EV charge points in collective housings remains complex and constitutes a major issue for the EV deployment at a large scale.
Moreover, EV charge in collective housing needs to a collective infrastructure approach which is a more efficient and standardized plan in the long term to supply the first users but also to meet the future needs according to the development of the electric mobility.
Several frames can be implemented to perform collective infrastructure for electric supply in the car parks of collective housing : connection to the common services, creation of a specific delivery point to supply the EV charge devices, or creation of a distribution electric feeder to connect delivery points at each EV charge point.
Whatever the held solution, Enedis is involved and aims to support landlords and condominiums in cooperation with electrician installers, and mobility operators, to provide technical advice and to carry out the works needed to deliver the power to the EV charge devices.

References

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[2] *Enedis*, https://www.enedis.fr/english

[3] *French Government*, http://www.statistiques.developpement-durable.gouv.fr/lessentiel/ar/199/1080/emissions-gaz-effet-serre-secteur-france.html, 2015 statistics

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[5] *France Stratégie*, Webconférence - Quelle place pour la voiture électrique dans la mobilité de demain ?, 2018-12-20

[6] *AVERE*, http://www.avere-france.org/Site/Article/?article_id=5887, 2017-03-31

[7] Loi d'Orientation des Mobilités,

[8] *Code de la construction et de l'habitation* – CCH, art. L111-6-4 et 5 (habitations collectives), art. R136-2 et 3 (existant – habitations)

[9] Infrastructures de recharge pour véhicules électriques (IRVE) – Recueil pratique – Version 2018 (Enedis, FFIE, GIMELEC, IGNES, SERCE)

[10] Guide de préconisation – Bâtiments neufs : Installations dédiées à la recharge des véhicules électriques ou hybrides rechargeables – Juin 2018 (Ministère de la transition écologique et solidaire, Ministère de la cohésion des territoires)

[11] Sequelec guidelines, French standard NF - C14-100

Authors

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D. Jacquemoux is an engineer from a French High School. He has been working for 35 years for Enedis. He has a huge and wide experience in distribution organization: operation, engineering, maintenance, smart grids projets. He managed operational team up to 100 technicians and engineers. He has worked for national certification to ISO 14001 & 9001. More recently, he was the sustainable development expert for Rhône Alpes Bourgogne regional direction. He is currently working on facilitating electrical vehicules integration on distribution grid, in particular in charge of operational coordination of EV projets for 3 regional directions (Sillon Rhodanien, Auvergne, Alpes) and is Enedis representative in AVERE Auvergne Rhône Alpes Association.

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O. Terral is an engineer graduated of INSA Toulouse in 1996. He worked for in thermal exchangers at Alfa Laval – Tetra Pak then he joined EDF as R&D engineer to develop electric innovative ovens for agro-industry. He becomed in 2000 key account manager at the commercial division of EDF leading the opening of the electric market with a customer portfolio of electronic and defence industries then he was sales manager of a commercial team in charge with real estate and building sectors. In 2010, he joined Enedis as Head of operation in west Ile-de-France region managing 380 technicians in charge with maintenance and emergency interventions on the grid. In 2015, he was deputy director of the operating procurement division in charge with purchasing all the civil and electric works of the DSO. He has joined the Electromobility Program of Enedis since January 2019 and is managing the key partnership developments.

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