

Procuring solar vehicle-to-grid (V2G) charging stations for electric vehicles

Barcelona Metropolitan Area (Spain)

Background

L'Àrea Metropolitana de Barcelona (AMB) is home to over 3.2 million people, with a population density of 5,093 inhabitants per km². In 2018, the Metropolitan Council of the AMB approved its [Climate and Energy Plan 2030](#), which established a series of actions necessary in the fight against climate change to achieve energy transition goals. This included an action to create a network of metropolitan 'Fotolineras' i.e. photovoltaic (PV) car-parking pergolas, usually located next to a public building, which are equipped with a charging spot for electric vehicles.

The Fotolineras network of solar charging stations will provide clean energy to charge electric vehicles, and, when no vehicles are around, can supply clean energy to local public buildings. By doing this, the network will improve air quality, tackle climate change, and support energy transition.

In addition, it was decided to install vehicle-to-grid (V2G) connections in two locations where the municipality already has an electric vehicle fleet. These allow bidirectional energy flow, meaning car batteries can also be used to store energy and send it to nearby public buildings when required.

Batteries are important to the energy transition. By using V2G technology, AMB has made it possible for car batteries to provide power to buildings during periods where solar energy production is lower than demand. Car batteries can also be useful for replacing energy demand during periods when energy prices are high.

Procurement objectives

After some initial pilot installations, AMB published a call for nine solar charging stations in November 2020, to be installed across the metropolitan area in the municipalities of Badalona, Esplugues de Llobregat, Montcada i Reixac, Sant Adrià del Besòs, Sant Cugat del Vallés, Sant Feliu de Llobregat and Viladecans. Most of the solar charging stations are open to anyone to use. Citizens who register will receive a card which will allow them to operate the charging points, except for the V2G charging points in Esplugues de Llobregat and Sant Cugat del Vallés, which are reserved for the municipality's own electric vehicles.

The solar charging stations had to guarantee that they could supply the necessary energy to fully charge an electric vehicle (car or motorcycle) in six to eight hours, as well as to supply part of the energy consumption of the adjacent municipal building, or provide energy to the power grid (if the site does not have a building nearby).



Images: Barcelona Metropolitan Area

The contract was divided into three lots. While the first two lots dealt directly with the supply and installation of solar charging stations, plus their maintenance during their first year of operation, the third lot sought experts who could help validate the technical documentation required as part of this technically complex installation, and the management of the installation work.

Criteria used

Subject matter of the contract:

Execution of 9 solar charging stations in the municipalities of Badalona (14.85 peak power (kWp), Esplugues de Llobregat (9.90 kWp and V2G), Montcada i Reixac (14.85 kWp), Sant Adrià del Besòs (9.90 kWp), Sant Cugat del Vallés (9.90 kWp and V2G), Sant Feliu de Llobregat (9.00 kWp) and Viladecans (14.85 kWp). The contract is divided into 3 lots. The first lot is for the execution of the works in the two municipalities requiring V2G connections. The second lot concerns the works in the other five municipalities. The third lot relates to the management of solar charging station installations.

Selection criteria:

For **Lots 1 and 2**, bidders must have proof of having supplied at least three solar canopy or photovoltaic (PV) pergolas with a peak power per pergola equal to or greater than 9 kWp, within the last three years.

For **Lot 3**, bidders must have proof of carrying out the management of three solar installations with a total peak power equal to or greater than 10kWp for each of the facilities, within the last three years.

Technical specifications:

Photovoltaic Modules:

required technical characteristics of photovoltaic panels include:

- Minimum module efficiency: 19.3% for all solar charging stations
- Operating temperature range: -40°C to 85°C
- Positive tolerance: 0 / + 5%
- CE marking
- Corrosion resistant aluminum structure.
- Degree of protection IP 65 or higher.
- Certifications: IEC 61215, IEC 61730, IEC 62716 and IEC 61701 or equivalents.
- Product warranty: 12 years.
- Performance Guarantee that 80% of the production with linear losses will still be achievable in 25 years' time.

Charging points:

charging points should be as universal as possible (i.e. should be able to be used by all electric vehicles, regardless of make or model). The recharging points will consist of two single-phase mode 3 Mennekes Type 2 sockets (230V 32A, 7.36kW) (enabling recharging within 6-8h) and system anti-vandal lock.

Installation, pergola and components:

- Connection: The solar charging stations should be able to direct surpluses of solar energy to nearby public buildings, and act as a back-up supply. The supply and execution of this connection is also required under this tender, including acquiring necessary authorizations.
- Structure and finish: the structure of the pergola should be made of galvanized steel, and painted red (using RAL 3020).

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- **Wiring:** the external wiring must be resistant to UV rays and wiring interior shall be halogen free and double insulated (1000V of protection). The wiring of modules should be protected from vandalism.
- **Inverter:** The rated power of the three-phase inverter may not be less than that proposed in the technical conditions of installation:
 - Minimum 10-year manufacturer's warranty
 - European performance (efficiency): 96% or higher
 - Certifications: EN 50524, IEC 62109-1, IEC 62109-2, IEC 61683 and EN 50530 or equivalents.
 - If the inverter is located outside, it must include suitable weather protection.



Award criteria:

Lots 1 and 2 were both scored out of 100 points. The economic offer was worth 51 points. The rest of the points were split between the 'Quality of the Technical Solution' and 'Guarantees and warranties'.

Quality of the technical solution (40 points):

- Technical proposal for the photovoltaic system (modules, inverter, pergola and elements for monitoring) (14 points)
- Technical proposal for conventional charging points and V2G (8 points)
- Technical proposal for the start of the contract and the maintenance included in the scope of the contract (7 points)
- Organisation of the team which will deliver the contract (5 points)
- Technical proposal for the execution of the contract (4 points)
- Technical proposal for services offered in the trial and testing period (including the number of tests performed, items checked, and duration) (2 points).

Guarantee and warranties (9 points):

- **Product warranty for PV modules:** the minimum product warranty of the PV modules is 12 years. For each year exceeding this minimum, 0.5 points are available (up to maximum 6 points).
- **Inverter guarantee:** the minimum guarantee for inverters is 10 years. For each year exceeding this minimum, 0.4 points are available (up to a maximum of 2 points).
- **Warranty for the structure:** the minimum warranty for the structure is 10 years. For each year exceeding this minimum, 0.25 points are available (up to a maximum of 1 point).

For **Lot 3**, 100 points were also available, and the economic offer was worth 51 points. The rest of the points were awarded according to the quality of the technical solution (49 points):

- Organisational structure of the team which will deliver the installation of the nine solar canopies (25 points)
- Proposal for monitoring (12 points)
- Methodology for the assessment of the technical documentation provided by the bidders of lot 1 and 2 (7 points)
- Quality control programme (5 points).

Results

The contract for lots 1 and 2 will run until 30 November 2022, and lot 3 will run until 30 November 2021. Lot 1 is worth approximately €307,400, Lot 2 approximately €376,255, and Lot 3 €32,529. The bids received did meet the specifications, however, only two bids were received for each lot. The low number of bids can be explained by the fact that solar PV charging stations are a niche product, and bidders were required to have experience in both PV pergolas and EV charging.

Environmental impacts

By expanding the network of solar charging stations, AMB is able to ensure that the energy to charge cars comes from renewable sources. In addition, when there are no cars needing charging, the energy produced can be used to power nearby public buildings.

In total, 83.25 kWp of solar panels were installed. The expected environmental impact of the solar charging stations has been calculated, based on data from existing installations and the following assumptions:

- 0,15 kg CO₂/kWh (data from Spain's electricity regulator)
- EV energy consumption: 18,5 kWh/100 km
- Combustion Vehicle: 120 g CO₂/km

Expected impacts: V2G

- Energy injected to the building from the electric vehicles per year: 42.375 kWh
- Energy supplied to charge the electric vehicles per year: 119.674 kWh
- From the energy injected to the building 6,35 tonnes of CO₂ will be saved every year
- From the energy supplied to the electric vehicles, 71 tonnes of CO₂ will be saved every year and the quality of air will improve.

Expected impacts: solar charging canopies

- Total PV energy produced per year: 116.550 kWh. Approximately 70 % of this energy goes to charging EV and the rest to the grid.
- 5,2 tonnes of CO₂ will be saved from the energy injected to the grid
- 52 tonnes of CO₂ will be saved from the energy charged to the EV

Lessons learned

Solar PV charging stations are a complex product, which require the right technical expertise. Selection criteria helped AMB to select suppliers who had the right knowledge and experience.

As charging stations are located in public spaces, it is important that they are durable and vandal-proof.

It is important that future e-fleet purchases are compatible with the current installations, in order to maximize the value of this important new piece of city infrastructure.

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For related information, please see European GPP criteria for [Road Transport](#) and the [Technical Background Report](#). The tender documents are available [online here](#).