APPLICATION NOTE

Power Factor Capacitor Banks: Why Placement Matters More Than You Think

Capacitor banks are often specified for power distribution systems after proper modeling and load flow analysis have been completed. Their primary role is to maintain power factor at a value set by the design engineer—usually to meet utility interconnection requirements. These requirements are not homogeneous and tend to vary depending on the type of connection the customer is requesting from their power provider.

While capacitor banks can serve many purposes, the most common motivation for installing them is to reduce electricity bills, which increase if the target power factor is not maintained. Achieving this requires accurate sizing, proper capacitor selection and careful procurement, commissioning and installation.

But there's another factor that can make or break the effort: the choice of location of the capacitor bank.

Why Location of Your Capacitor Bank Is Critical

To circumvent a power factor penalty, the utility meter of the facility must register the targeted power factor. This only happens when the power system infrastructure behind the utility's meter maintains adequate reactive power.

What does this mean? The kilovolt-ampere reactive (kVAR) should be injected from somewhere downstream (or "behind") the meter. This is fundamental to how the utility meter calculates power and energy conditions at the consumer connection point.

Let's take a look at several visual examples.

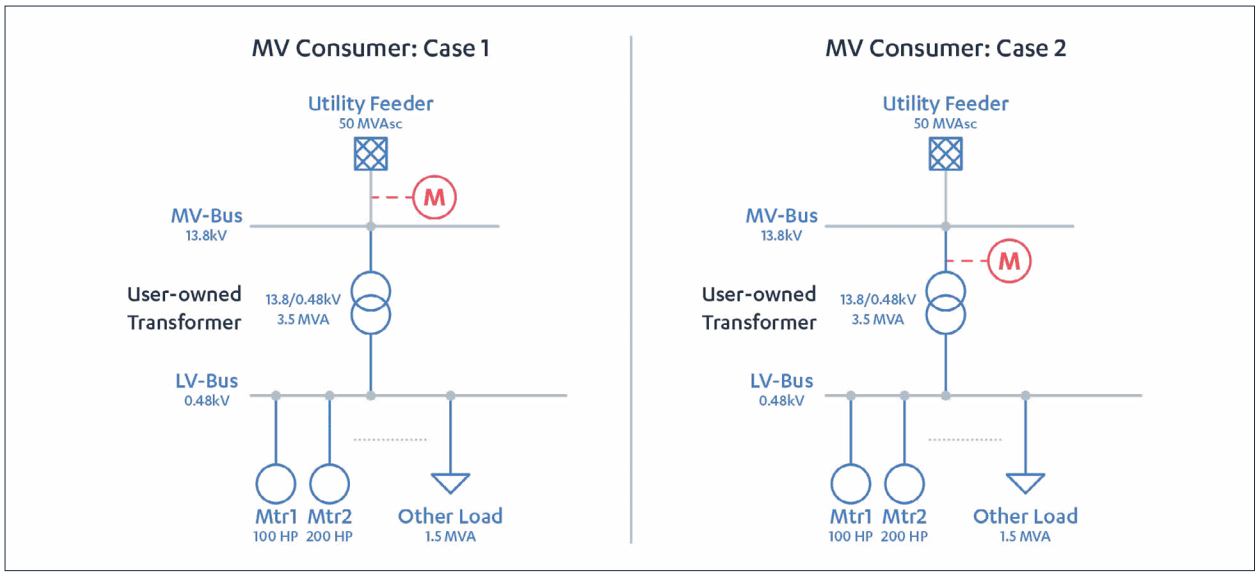
Example 1: Medium Voltage Consumer

Consider a medium voltage (MV) consumer who is "primary" metered at the utility distribution voltage level of 13.8 kV. The utility meter location could vary depending on such factors as feeder location, distribution transformer or type of feed (e.g., above-ground or underground primary feed).

Two possible meter locations are shown in the images below:

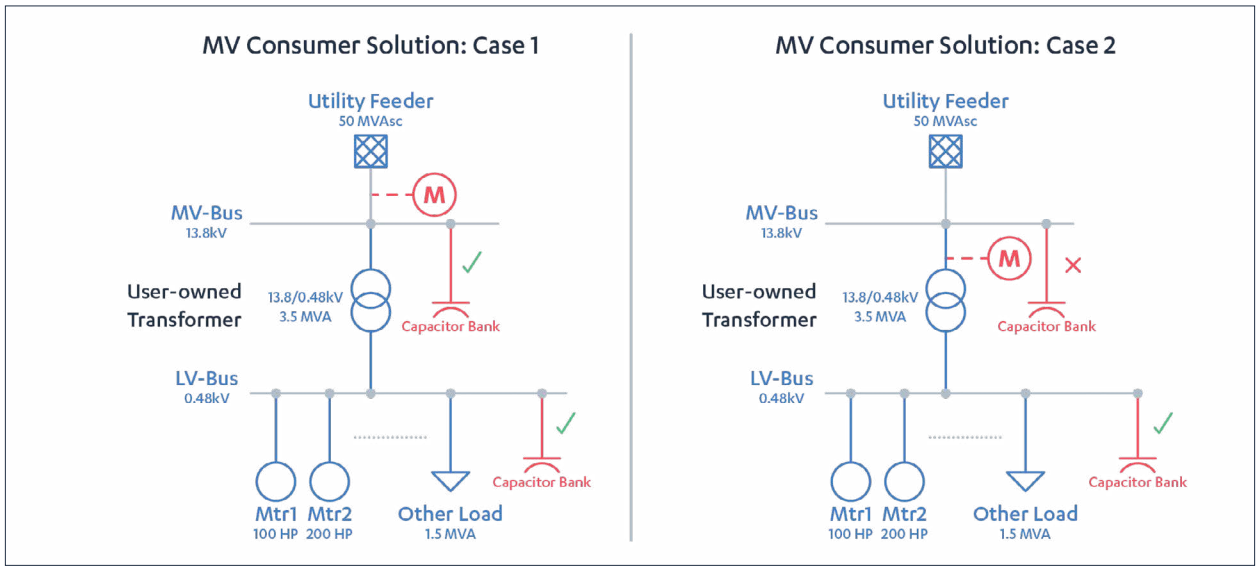
- At the incoming feeder location (Case 1)
- At the primary transformer main breaker (Case 2)

In both cases, the transformer is customer-owned due to the primary meter location.



Placing a capacitor bank in different locations can drastically influence how the utility meter records kVARs:

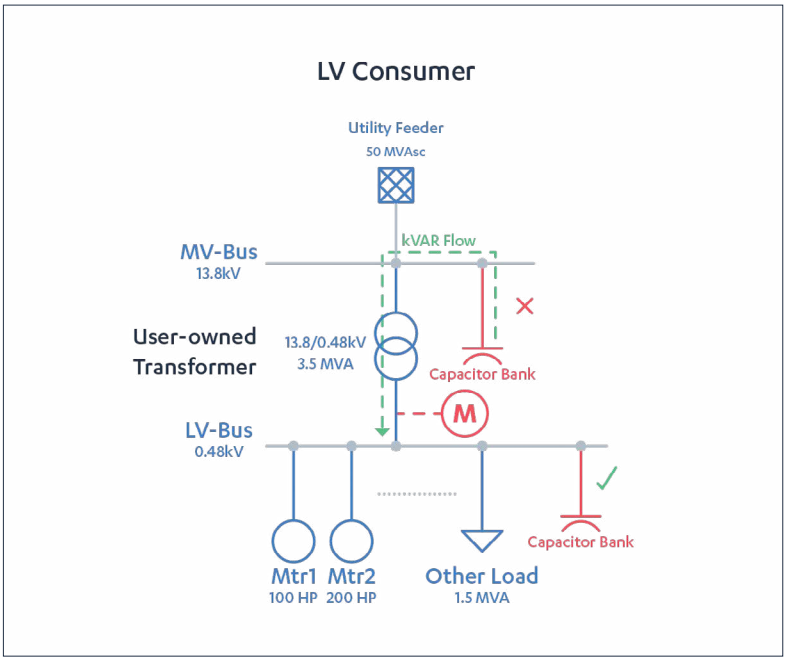
- **Solution Case 1:** The capacitor bank can be placed at both proposed locations
- **Solution Case 2:** The capacitor bank can only be installed on the transformer's secondary side, since the utility meter's current transformers are on the primary side



In Case 2, with compensation done on the low voltage (LV) bus, further measures must be taken to ensure that the inductive impact of the transformer is considered. This may require an elevated power factor target at the LV bus to compensate accordingly.

Example 2: Low Voltage Consumer

For an LV consumer who is metered at the transformer secondary, placing a capacitor bank at the MV location provides no benefit. It neither achieves a necessary power factor target, nor supplies reactive power compensation to the load.



In this case, the transformer is supplied by the utility, and the metering point is on the secondary. Because the current measurement devices are on the secondary side of the transformer, this system configuration does not require consideration of the inductance in the feeder transformer.

Beyond Metering: Designing the Right Solution

Most modern power systems attempt to correct power factor near the utility meter location. This ensures the power factor correction system measurement devices mimic what the utility registers. However, this is not always the most effective approach for every scenario.

For instance, a consumer may want to free up space on a transformer, feeding predominantly inductive loads downstream from the main point of measurement. This may be a good opportunity to perform a centralized power factor correction at the downstream location in addition to a system close to the utility point of connection.

Partner with the Experts

Determining the right capacitor bank location can optimize performance, avoid penalties and reduce energy costs. But the nuances of meter placement and load type make every project unique.

Powerside is here to help. Our Engineering Services team, exclusively focused on power quality, specializes in designing and implementing tailored solutions that address your exact needs. Let our experts help you find the right capacitor bank solution and location today.

powerside.com/engineering-services

Contact Us

United States
Alameda, CA
1-888-736-4347

Canada
Montreal, QC
1-877-333-8392

sales@powerside.com
powerside.com