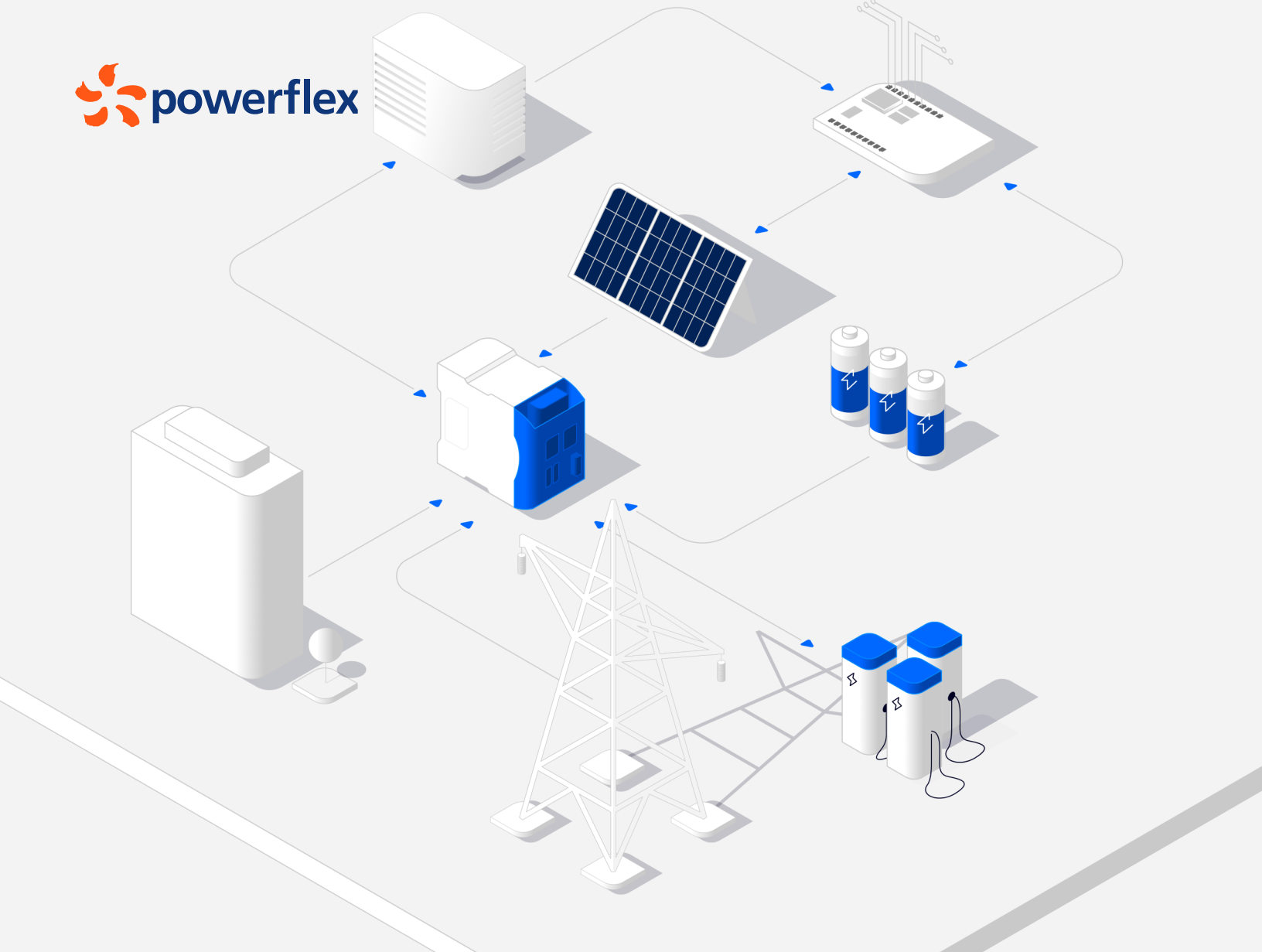




+ E-BOOK

EV Fleets + DER Integration

Key Considerations for Coordinating Charging
With Solar, Storage, and Other Energy Resources

13-MINUTE READ

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Introduction

Companies and institutions of all kinds are embracing the clean energy transition by redesigning their operations to become more sustainable, cost efficient, and resilient.

Organizations that operate fleets have a unique challenge as they begin to move from gas- and diesel-powered vehicles to electric — and plan for the increased power demand that shift brings.

Fleet and facility managers must collaborate with each other to an unprecedented degree as they adopt new technologies such as EVs, solar generation, and battery energy storage. Just as their workflows will mutually benefit from strong communication, the technologies themselves also must be properly integrated to communicate and support each other.

This e-book will introduce the advantages of integrating EV charging with distributed energy resources (DERs), as well as the basic technical considerations of how to do so. Most importantly, it will provide real-world examples of successful implementations, going beyond theoretical discussion of co-locating DERs and EV charging with use cases that may be helpful to asset owners.

This type of systems integration has many benefits that synergize with the existing use cases for DERs, such as:

Capacity Expansion: Overcoming the capacity limitations of power-constrained sites.

Emissions Reduction: Achieving your organization's sustainability goals by maximizing the use of zero-emissions energy and transportation.

Resilience: Leveraging energy and mobility systems that continue functioning through grid disruptions.

Cost Optimization: Minimizing exposure to retail energy costs and stabilizing long-term operating costs.

The Necessity to Integrate

As fleets go electric and facilities become generation and charging hubs, it's crucial to integrate fleet charging with onsite energy assets.

To better understand why, consider this unfortunate yet highly plausible scenario:

A school district in California receives a state grant to build rooftop solar and a federal grant for battery electric buses and charging. The two projects are managed by different teams, and they aren't coordinated with charge management or microgrid technology. When both systems begin operating, the school is shocked to see its electric utility bills go up significantly. It is generating solar during the daytime and selling to the grid at less than retail rates, and then charging buses at night with power purchased from the utility. The school is losing the cost-saving opportunities and carbon reduction benefits of charging directly from solar and is at the mercy of an increasingly vulnerable power grid.

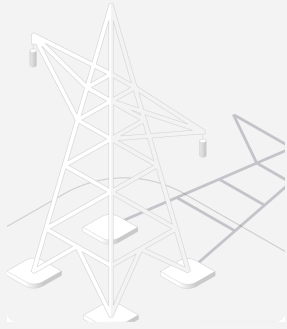
By integrating and coordinating charging systems with DERs, your facility can avoid these pitfalls and realize several benefits:

GHG Reduction and Cost Optimization

With coordinated solar generation and EV charging, organizations can manage operating and energy costs as well as curtail greenhouse gas emissions by using emissions-free solar energy to help power chargers.

Resilience

Many types of fleets are considered critical systems, requiring failsafes to continue operating in emergency conditions. Solar-plus-storage with microgrid controls and backup generators can offer critical resilience to keep fleets running in the face of power outages.



“Natural disasters, such as cyclones, earthquakes, hurricanes, wildfires, and severe storms — and the power outages resulting from these disasters — have affected millions of customers and cost billions of dollars. The growing severity of wildfires and extreme weather events in recent years has been a principal contributor to an increase in the frequency and duration of power outages in the U.S.”

— U.S. Government Accountability Office

Capacity Expansion

Charging a fleet of 50 electric transit buses could consume more power than 800 typical U.S. households. EV charging load management is one highly effective solution for installing EV chargers on a site with limited power. However, there are scenarios in which load management will need to be supplemented with integrated DERs such as solar and/or storage to expand the available capacity for EV charging. A robust charge management system (CMS) can allow for both solutions to be deployed concurrently.

What Are DERs?

The National Laboratory of the Rockies (NLR) defines distributed energy resources (DERs) as “small, modular, energy generation and storage technologies that provide electric capacity or energy where you need it,” which can “be either connected to the local electric power grid or isolated from the grid in standalone applications.”

DERs are increasingly viewed as a solution to distribution grid challenges — and they can help resolve site-level limitations too. NLR recognizes the ability of DERs to “delay, reduce, or even eliminate the need to obtain additional power

generation, transmission, and distribution equipment and infrastructure” and “manage energy bills and ensure reliable power by augmenting your current energy services.”

For the purposes of this e-book, DERs can be grouped into two broad categories: onsite generation and controllable storage.

Generation

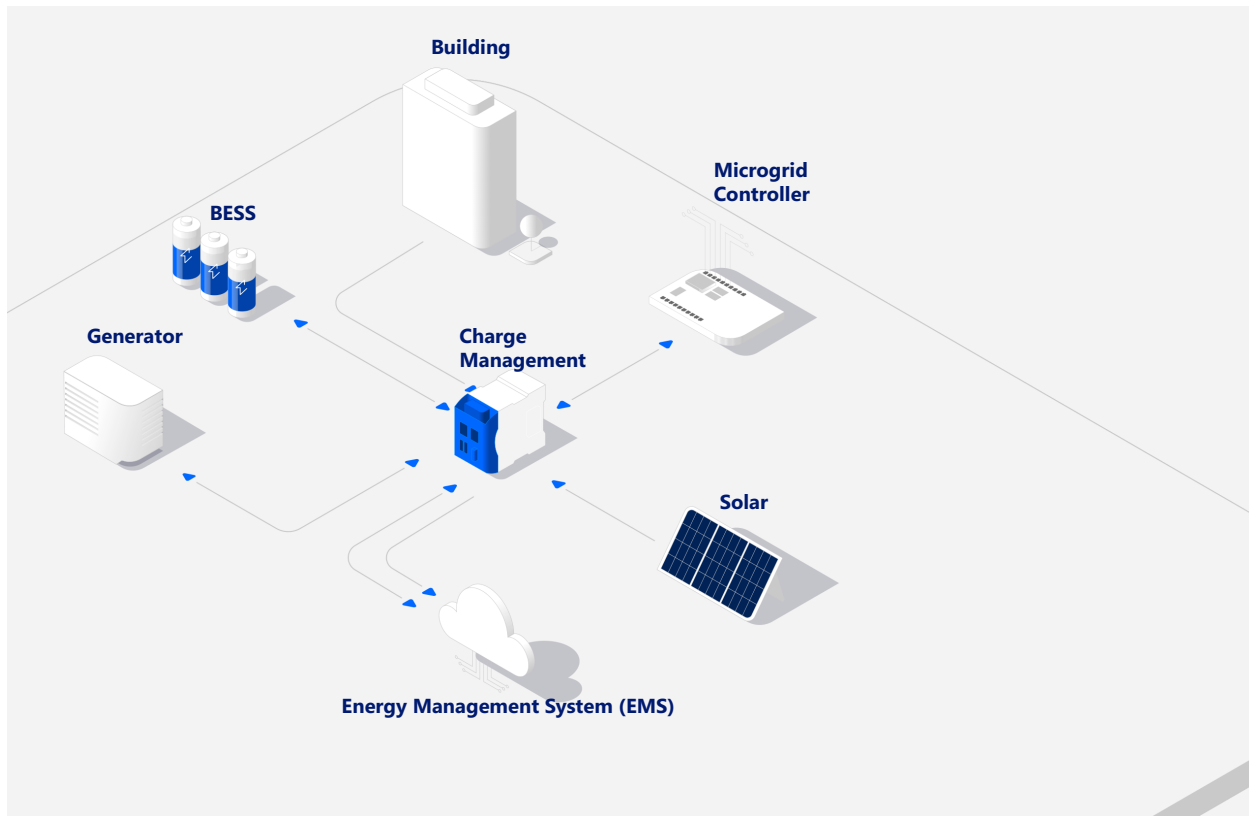
Solar and combustion generators are both examples of onsite energy generation. Photovoltaic (PV) solar energy generation can reduce a facility’s carbon impact and its energy costs, and is considered an uncontrolled supply. Traditional backup generators, such as diesel or gas units, are controllable supply systems that are generally employed when the grid is unable to deliver power. Both types of systems can be integrated with EV charging to support different goals such as self-consumption, cost optimization, or resilience.

Controllable Storage

Battery energy storage systems (BESS) are installed banks of batteries, also known as stationary storage. These assets can be programmed with a smart inverter to charge directly from onsite solar or from relatively cheap grid power, and then discharge to power facility loads when needed. They can also be employed in cost-saving applications such as powering critical loads during peak hours or exporting to the grid by participating in a demand response program. A BESS can also be used to increase the effective power available to supply an EV fleet.

Electric vehicles can become controllable storage if they are equipped with bidirectional charging capabilities and a compatible CMS, acting much like a BESS would. When EVs are deployed as backup power or to reduce effective demand during peak hours, it’s called vehicle-to-building (V2B). When they are deployed for export to the grid, it’s called vehicle-to-grid (V2G).

Figure 1: CMS Controls Charging in Coordination With External DER Components



How Do DERs Communicate With EV Chargers?

Communication between various onsite DERs is the key to dynamic real-time optimization in response to changing conditions.

This e-book focuses on intra-site communication — the ways in which DERs and the CMS communicate with each other to coordinate operations behind the meter. In contrast to previous strategies, where DERs responded reactively to EV charging occurrences, the use of a robust CMS with a local controller enables a more proactive approach. This allows for near real-time adjustment of charging load based on DER behavior while still considering vehicle needs, thereby exerting

greater control over variables and minimizing the need for reactionary adjustments in DER management.

The communication system could take one of two forms. The first is a **centralized decision-making architecture**, such as a microgrid controller that receives information from each DER on site and sends commands to control individual components of the system.

The alternative is a **decentralized architecture**, where each individual component is pre-programmed to react to a select set of conditions. This is a less complex, relatively more cost-conservative structure.

When integrating EVs with DERs, the CMS plays a critical role as the management tool of charging operations and the communications center, sending and receiving signals. To get the most value from EV charging within a DER system, consider the following CMS capabilities and functions:

- 1 Does this CMS include a controller installed on site?
- 2 Can this CMS integrate with a microgrid?
- 3 Can this CMS respond to other DERs using metering or other signals?
- 4 Can this CMS communicate unidirectionally and bidirectionally?
- 5 When does this CMS operate and how does it know how to operate?

DERs are most useful when they are controllable and capable of sending real-time data. There are several ways to set this up:

Modbus

Modbus allows the CMS to participate in a centralized architecture by communicating bidirectionally with a microgrid controller behind the meter at a site.

Modbus is a communications protocol that is designed specifically for programmable logic controllers (PLCs). Programmable logic controllers are a type of simple computer that can be installed on an industrial site such as a charging depot. They are often seen in Internet of Things (IoT) technology or in edge

computing. Given that DERs often have their own PLC that is subservient to a higher-level main PLC, Modbus is the de facto standard in the microgrid landscape.

Meters

Meters allow the CMS to participate in a decentralized DER architecture by providing information in a single direction to the CMS so it can receive information and react.

Meters located throughout your subdistribution panel and inside the chargers themselves allow the charge management system to recognize load and generation at different parts of the subdistribution architecture. This allows for the most dynamic response to changing onsite energy conditions.

Digital Signals

Individual assets at a site can send signals to a CMS such as ChargePilot® by PowerFlex to trigger an EV charging response. Digital signals allow the CMS to participate in a decentralized or centralized DER architecture by providing information in a single direction that the CMS can react to.

Digital signals fed into a local controller from various other sensors or control technology offer an extremely reliable and flexible tool for the CMS to interact with backup generation or more complex site setups.

Application Programming Interface (API)

An Application Programming Interface is a bit of code that helps two programs exchange data. Each API has its own documentation that tells developers how to build their corresponding API. APIs typically run over the internet, connecting cloud-to-cloud or other cloud-to-X systems, and can use either wired or wireless network connections.

When thinking about the best communication protocols for DERs, it's important to keep two concepts in mind: the criticality of data being transferred and the reliability of the connection.

Wirelessly connected APIs are suitable for the exchange of data with low criticality that is not time sensitive. However, power control communications should always

be transferred using reliable physical mediums with built-in redundancy and relatively low latency, such as Ethernet cabling connected to a PLC. Ethernet routinely supports 10 Gbps or more, while Wi-Fi speeds are generally less than 1 Gbps in field applications. This is especially important for DERs, as the communication often has a functional safety aspect regarding importation or exportation limits.

Building Your Project Team

Integrated projects require a diversity of skills and knowledge, which can mean working with a variety of internal and external stakeholders. An example of a potential project team is below.

End-User Stakeholders



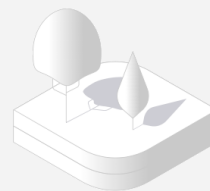
Fleet Manager

Responsible for the fleet's mobility and reliability



Facility Manager

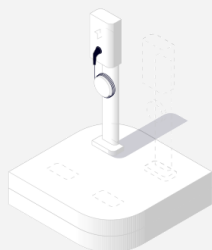
Manages capital and energy costs, as well as space considerations



Sustainability Manager

Sets mobility and energy transition goals

Project Vendors



Installation Contractor

Accountable for quality of construction



Project Manager

Cost and timeline owner



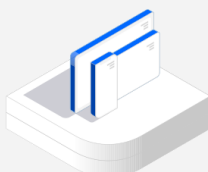
Systems Engineer

Optimizes the system to achieve customer priorities



Consultant

Brings expertise to fill knowledge gaps



Product Engineer

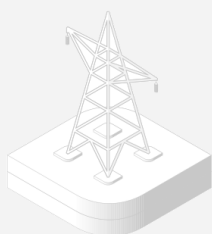
Systems integration requires involvement from technology providers



EPC

May offer a turnkey solution, including operations and maintenance

Public Agencies



Utility

Committed to serving customers' power needs in balance with wider grid considerations



Authority Having Jurisdiction

Permitting agency

Designing Systems to Achieve Project Goals

DER systems with EV charging can be structured in many different ways depending on the operator's goals for the site:

- 1** Do you want to maximize charging on a power-constrained site?
Consider implementing EV charging load management to stay within the site's power limit.
- 2** Do you want to maximize carbon reduction and cost savings?
Consider solar for self-consumption paired with energy storage.
- 3** Do you want a system that can resiliently operate independently of the utility grid?
Consider a microgrid with islanding capability.

There is no one-size-fits-all solution to design a DER system. It is important to right-size the project, maximizing fleet performance and other operator goals while minimizing complexity and costs. A simple system is often the best choice if it adequately meets your fleet's needs.

In all cases, PowerFlex recommends starting with an assessment of your fleet and facility needs. This may include:

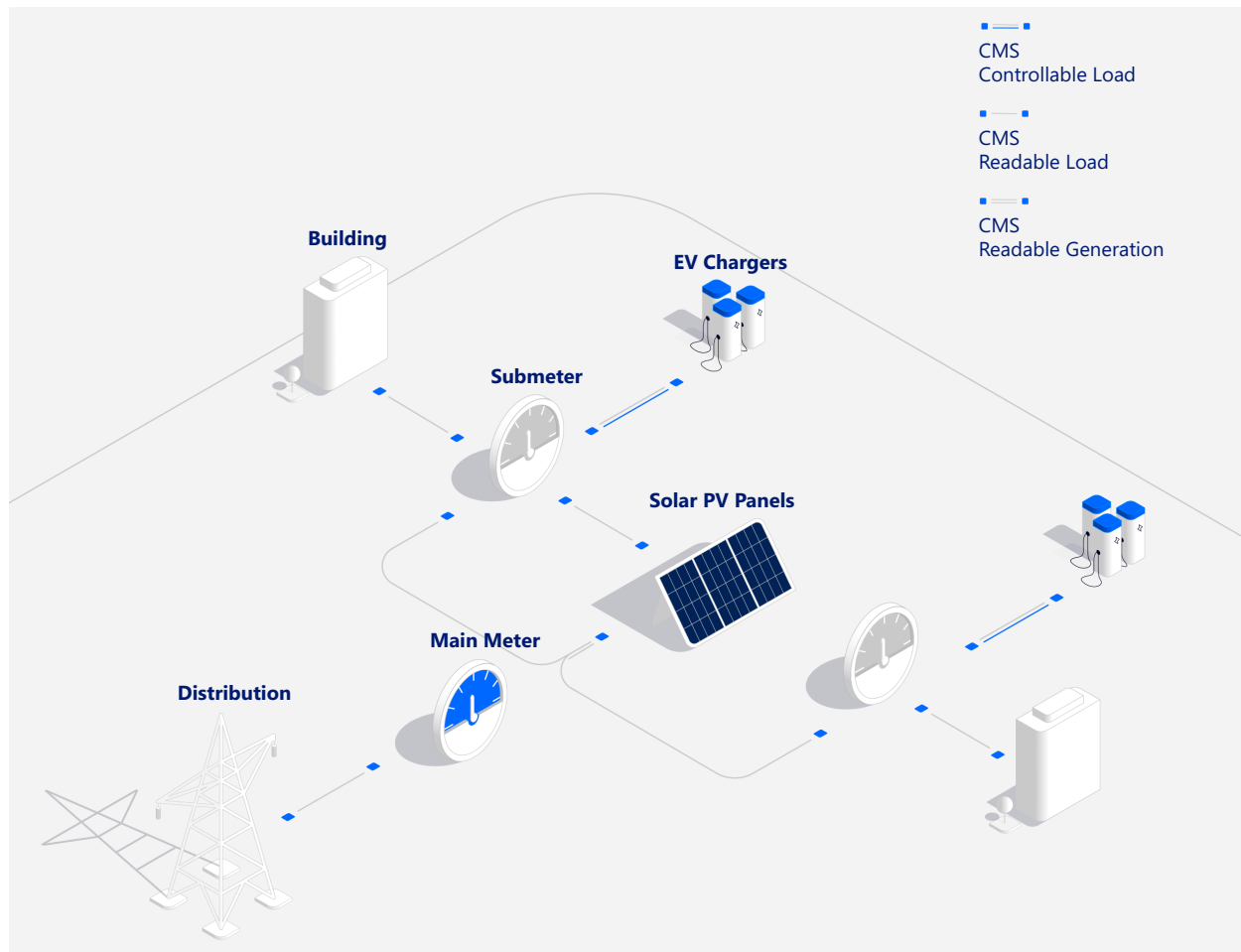
Electrical Infrastructure Site Review: Determine how much power you currently have and how much you will need.

Fleet Charging Simulation: Determine what your operating costs will be over time and what hardware you need, considering both managed and unmanaged charging scenarios.

Optimizing a Power-Constrained Site

The results of your electrical infrastructure site review and conversations with your utility provider will determine the site's available power capacity. If this limit is less than the rated power capacity of the charging system you hope to install, you will need to adjust your strategy. A service upgrade from the utility may not be immediately available or cost effective, but several technological solutions are possible.

Figure 2: Example DER + Charging Site Configuration



EV charging load management is often the most cost- and time-efficient option available in these scenarios. A CMS can safely use load management to prevent charging from exceeding the grid capacity, avoiding the need for a service upgrade and maximizing the charging capacity that can be installed with available power. In some cases, an onsite solar-plus-storage system may be able to bridge the gap between available grid power and charging demand.

If a site has solar and EV charging installed, it is usually financially beneficial to maximize self-consumption of the solar energy generated on site, depending on how the local utility compensates for distributed solar that is fed back into the grid. What's more, charging vehicles directly from onsite solar generation results in zero emissions and alleviates distribution grid congestion.

One way to do this is to use an onsite meter to read the generation and load at the site. An onsite meter can be placed at the interconnection level, allowing the chargers to dynamically use more power when solar is being generated.

This technical concept can be expanded to include meters placed throughout the subdistribution hierarchy of a site, allowing for both the application of static and dynamic power throughout a site's distribution structure. The charge management system's capabilities are then combined with proper planning and sizing of overcurrent protection devices (OCPDs), like fuses and molded case circuit breakers (MCCBs). This approach ensures the greatest possible optimization of power on even the most complex sites.

Case Studies

Microgrid for Resilience and Cost Optimization

Distributed energy resources may also be connected and controlled with a microgrid. Islanded microgrids have the ability to operate independently of the grid in times of outage or peak rates. Microgrids with export capabilities can go a step further to sell power to the grid and generate revenue, although these are only allowed in certain states.

In order to integrate EV fleet charging into a microgrid, the CMS must be capable of working with open standards communications protocols such as Modbus and must have the resilience to handle complex situations such as connection loss to various system components such as the backend, the chargers, or the microgrid controller. You will also want to evaluate the CMS' responsiveness to changing onsite conditions such as islanding.

For an example of a microgrid project that delivers both resilience and cost optimization, consider the Brookville Smart Energy Bus Depot in Montgomery County, Maryland.

For this landmark, first-of-its-kind microgrid project developed by AlphaStruxure, ChargePilot® by PowerFlex was implemented as the smart charging and energy management system.

Managed charging for up to 70 electric buses

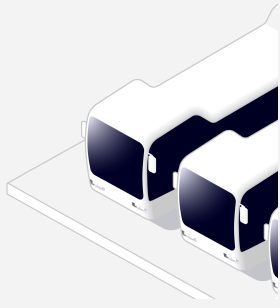
Integrated with the Schneider microgrid controller

6.5-megawatt (MW) microgrid features 1.6 MW of solar, three 633-kilowatt (kW) generators, and 3 MW of battery storage

A First-of-Its-Kind Resilience Application of a Unique Backup Generator Solution

How would a backup generator be used to support fleet charging in the event of grid disruption? If the generator capacity is less than the load management setpoint for the grid capacity, how would that work? What if the generator capacity is less than grid-connected power availability?

One of the unique features of ChargePilot® by PowerFlex is that it can be configured to switch the site's power limit to safely operate on backup generation without the need for a full microgrid setup. This means the end user does not have to pay to size the backup generation to match the grid connection. This ability provides fleet managers with independence from the power grid to keep their fleets running no matter what.



In a first-of-its-kind application, Rhode Island Public Transit Authority uses ChargePilot® by PowerFlex to manage 1,800 kW of charger capacity installed at its Broad Street facility with 1 MW of grid power available.

It is able to quickly switch to a backup 600-kW generator if the grid goes down, safely and capably managing all four ABB HVC 450 pantographs under a second load management setpoint dedicated to this scenario. ChargePilot® by PowerFlex is able to swap between these two setpoints nearly instantaneously as soon as the power outage occurs.

Wrapping Things Up

When fueling becomes charging and your fleet goes electric, EV infrastructure becomes an essential part of your facility's energy systems.

There are numerous benefits to integrating EV charging with other onsite energy assets such as solar, storage, and microgrids, including cost savings, sustainability, resilience, and overcoming power constraints. [ChargePilot® by PowerFlex](#) and other PowerFlex software platforms allow for the total optimization of your fleet and distributed energy resources.

Talk to a PowerFlex expert
today to get the most out of
your EV charging investment
through DER integration.



About PowerFlex

PowerFlex is a clean technology solutions company making the transformation to carbon-free electrification and transportation possible. Our intelligent energy management platform PowerFlex X™ monitors, controls, and co-optimizes onsite assets like EV chargers, solar, energy storage, and microgrids — reducing overall energy costs through patented algorithms that maximize distributed energy resources.

PowerFlex is the largest installer of commercial solar in the United States, with over 500 megawatts (MW) of total solar capacity plus 50+ megawatt-hours (MWh) of battery energy storage. PowerFlex also manages more than 70,000 EV chargers nationwide, making it the largest hardware-agnostic EV charging provider in the U.S.

Through intelligent charging management and bidirectional vehicle-grid integration technology, PowerFlex enables electric vehicles to serve as flexible energy resources for transit agencies, school districts, and fleet operators.

PowerFlex is backed by EDF power solutions North America, Manulife Investments, and The Mobility House.

Visit powerflex.com for more information and connect with us on [LinkedIn](#) and [YouTube](#).

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