NC STATE UNIVERSITY

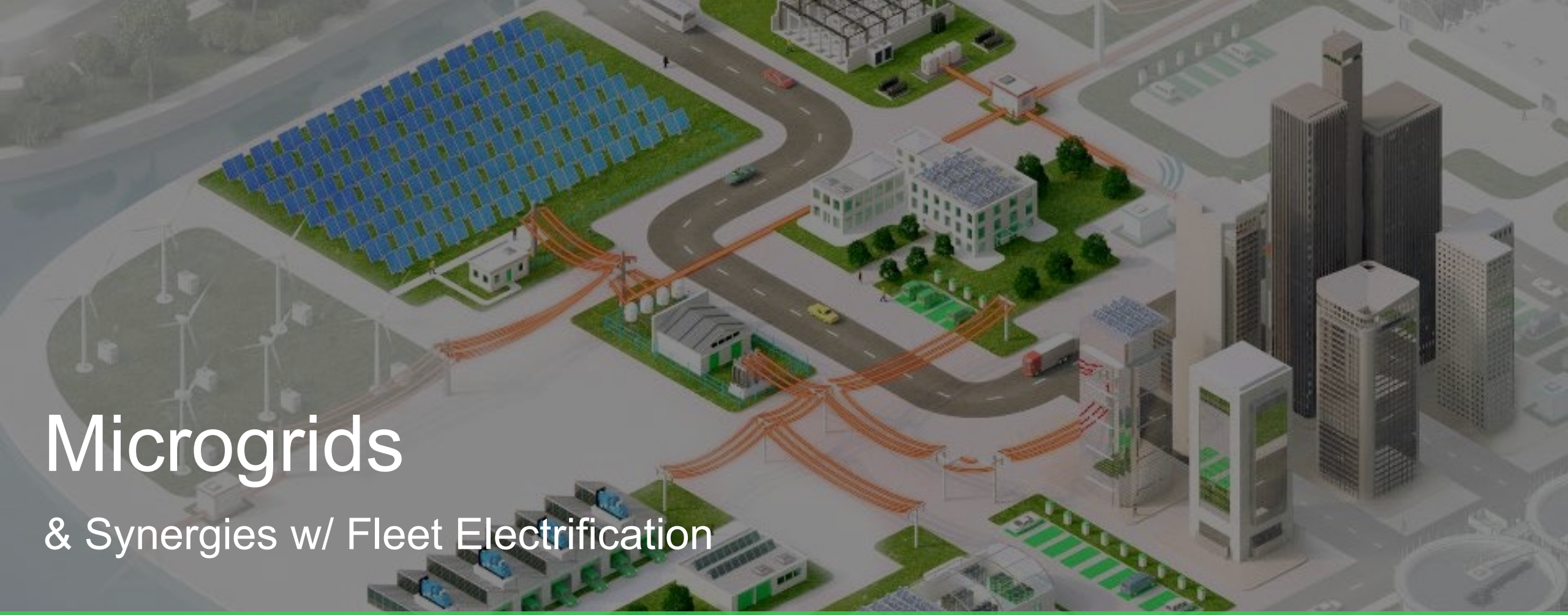
SUSTAINABLE FLEET TECHNOLOGY CONFERENCE & EXPO 2023

Track C Session 4: Integrating Fleet and Facility Energy Planning

August 16, 2023

NC CLEAN ENERGY TECHNOLOGY CENTER

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION



Microgrids

& Synergies w/ Fleet Electrification

Presented by:

Bill Pfleger
Manager, Project Development & Engineering – Microgrid
(615) 462-8115
william.pfleger@se.com

SUSTAINABLE FLEET TECHNOLOGY
CONFERENCE & EXPO 2023

Life Is On Schneider Electric

Schneider Electric, a global company, leading the digital transformation of Energy Management & Automation

$36.2B	+12%	5%	$35.8B	128,000+
FY 2022 revenues	Organic growth in 2022	FY revenues devoted to R&D	Energy assets under management	Employees in 100+ countries

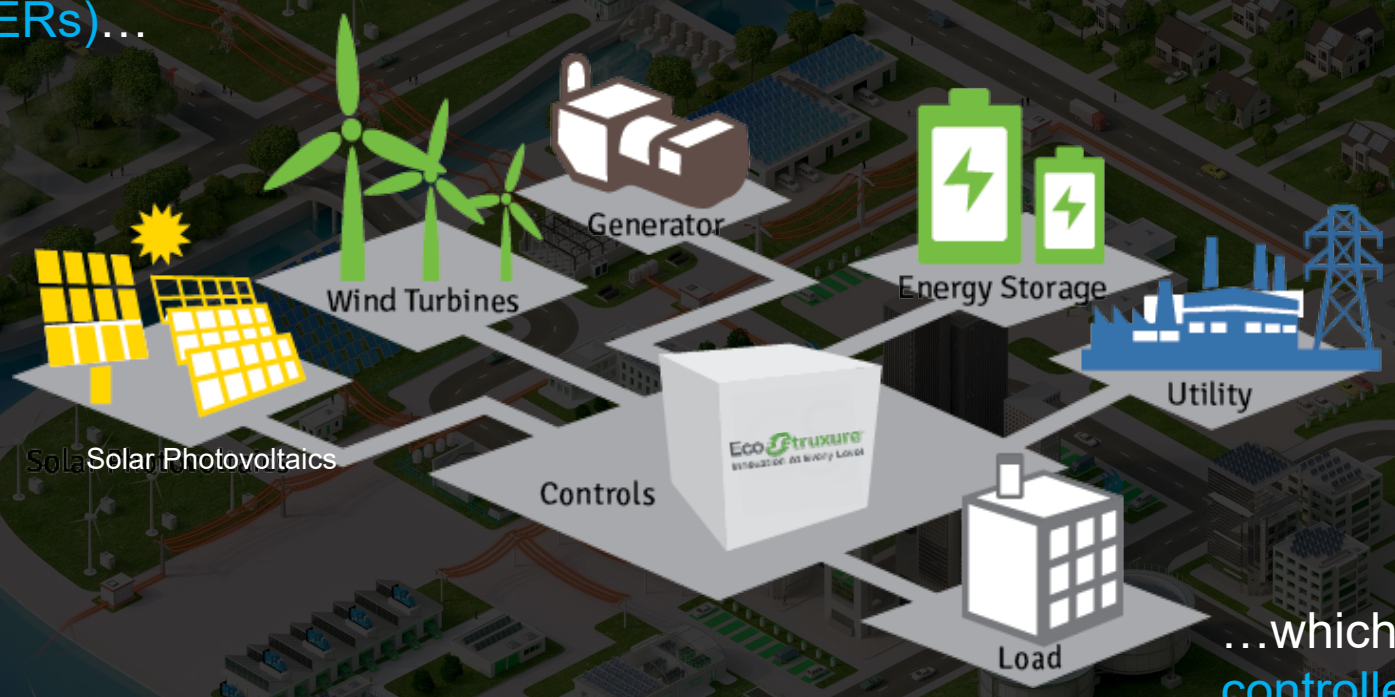
Our mission is to make life Safe, Reliable, Efficient, Sustainable & Connected

Our Legacy Brands

SQUARE D, invensys, TELVENT, VERIS INDUSTRIES, t.a.c, PowerLogic, AutoGrid, IA Intelligent Automation Series, CLIPSAL LIGHTING CONTROL, VICONICS Beyond Comfort, OSIsoft, PELCO, AVEVA, MGE UPS SYSTEMS, etap Powering Success, AndoverControls Controlling Tomorrow's World, APC Legendary Reliability, BARBER COLMAN COMPANY, RIB running together, Wonderware, Telemecanique, SummitEnergy, xantrex, Merlin Gerin, ASCO Power Technologies, AREVA

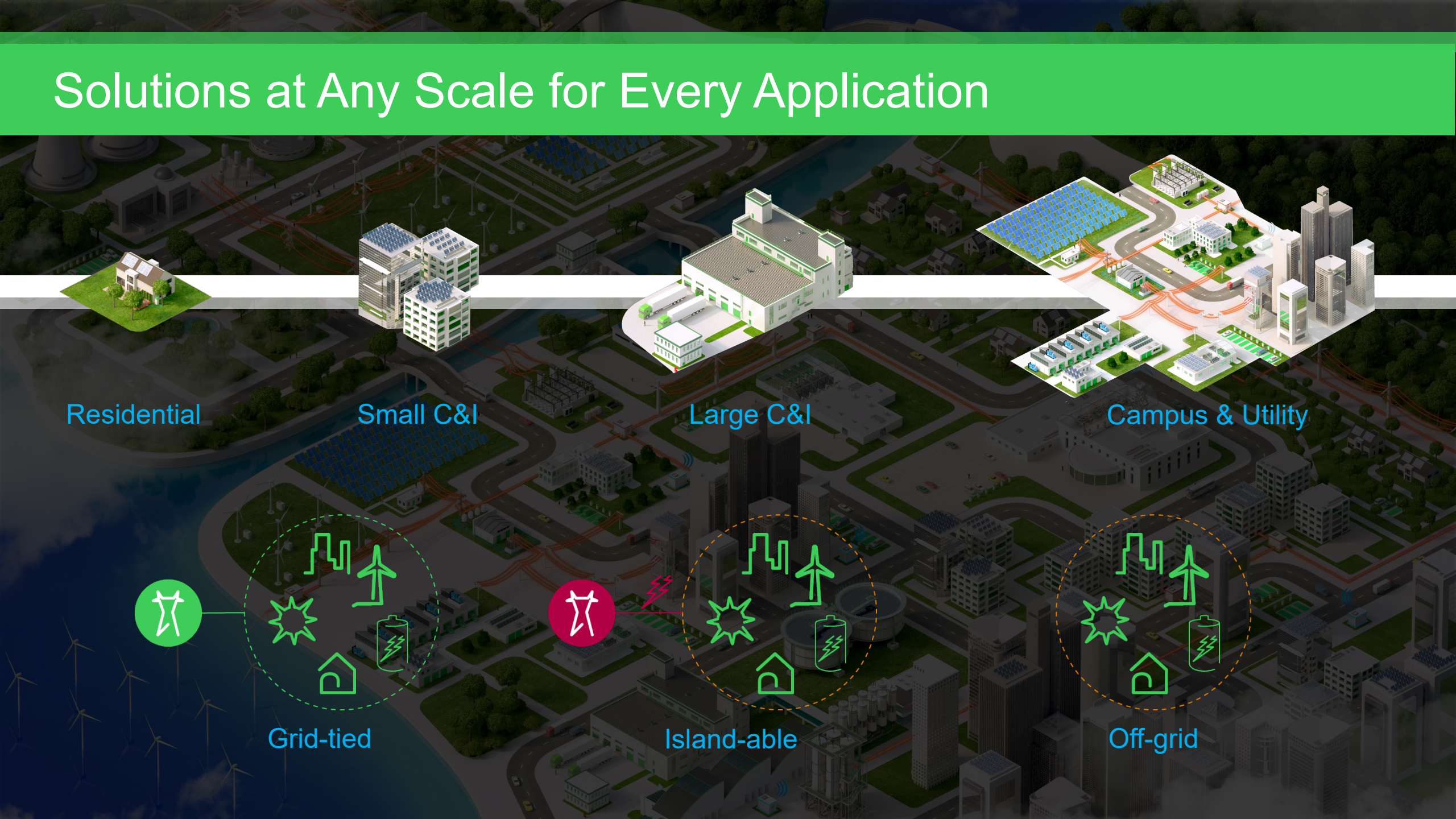
What is a Microgrid?

An integrated energy system consisting of interconnected loads and distributed energy resources (DERs)…



…which as an integrated system can be controlled as a single entity and operate in parallel with the grid **and/or** in an intentional *islanded* mode.

Solutions at Any Scale for Every Application



Reasons end users are choosing microgrids

High uptime requirements

- Critical infrastructure
- Outages due to:
  - Storms
  - Wildfires
  - Unplanned utility disruptions
  - Facility equipment failure
  - Power quality issues
  - Single point of failure

Need lower & more predictable costs of energy

- Utility increasing cost of electricity
- Utility enacted time of use rates
- High demand charges from peak power usage
- Take advantage of grants, tax incentives, and other funding to stabilize power supply.

Need to lower emissions leveraging onsite energy

- Company sustainability targets
- Government mandates
- Customers require cleaner supply chain
- Scope 2 & 3 Emissions targets

Need to increase existing site capabilities

- ***Adding Electric Vehicle chargers / Fleet electronification***
- Converting systems from gas to electric
- Adding new equipment requiring increased utility capacity
- Plans to add PV and/or other DERs
- Planned electrical infrastructure upgrades

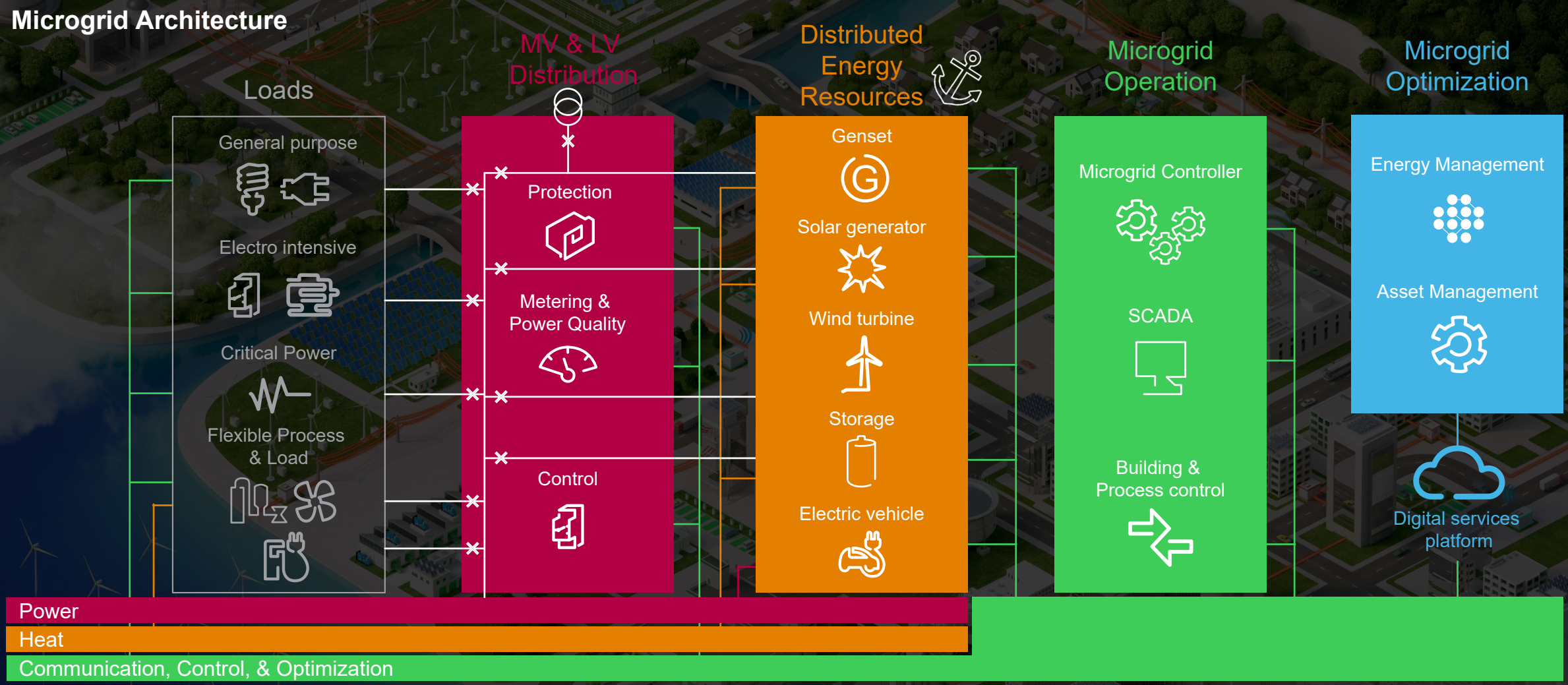
RESILIENCE

COST OPTIMIZATION

SUSTAINABILITY

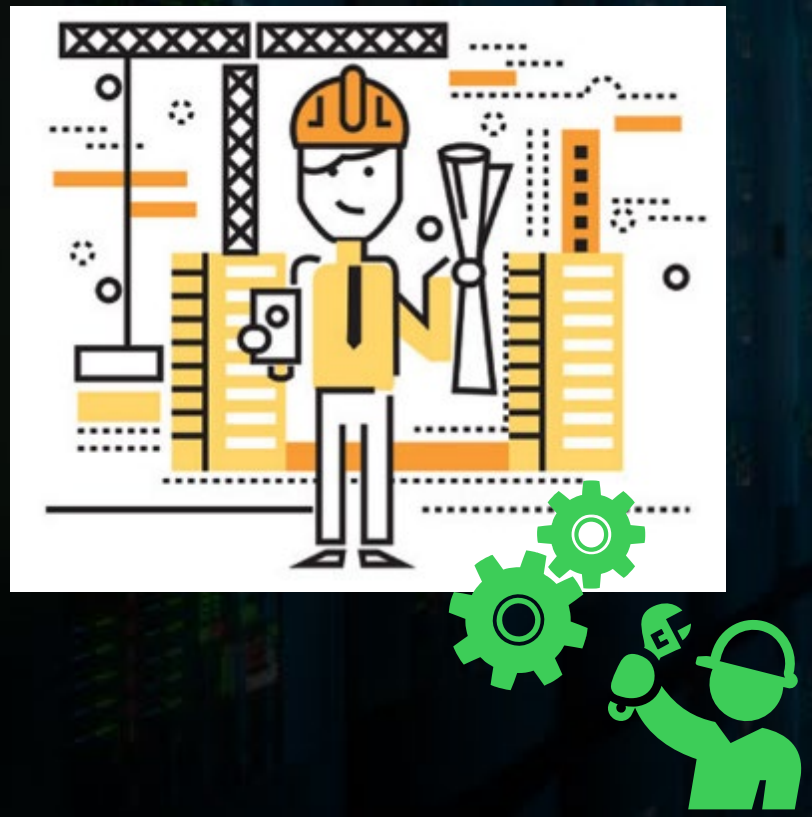
EXPANSION

What is in a Microgrid – Major System Components



Don’t Forget Microgrid Services

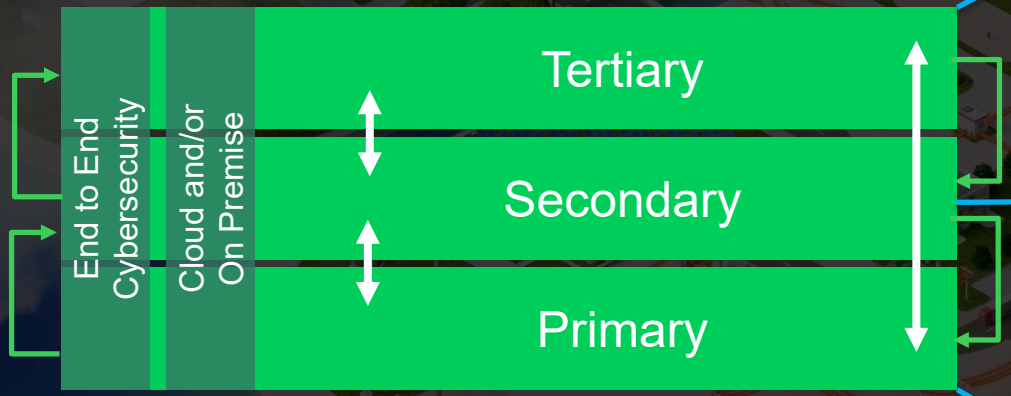
Requires allocation of Capex & Opex budgets



- Engineering:
  - Feasibility studies & project qualification analysis (financial & technical)
  - Design studies (e.g. load flow, dynamic stability, archflash, etc.)
  - Full system specification & design w/ stamped construction drawings
- Operational:
  - Troubleshooting of alarms & operational issues
  - Ongoing monitoring & root-cause forensics of events
- Maintenance:
  - Periodic exercising of DERs – e.g., generator emergency systems
  - Periodic maintenance of switchgear, DER and controls
  - Ongoing controls testing program – verify control sequences
- Financial Reporting:
  - Financial audit of economic optimization to monitor return on investment (expectation from energy-as-a service)
  - Ongoing carbon emission reporting

A Little More on Microgrid Controls

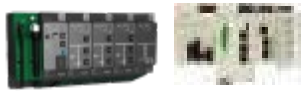
Advanced Microgrid Control Layers



Energy Management System

- Optimize DERs and maximize ROI
- Response times in minutes

Power Management System

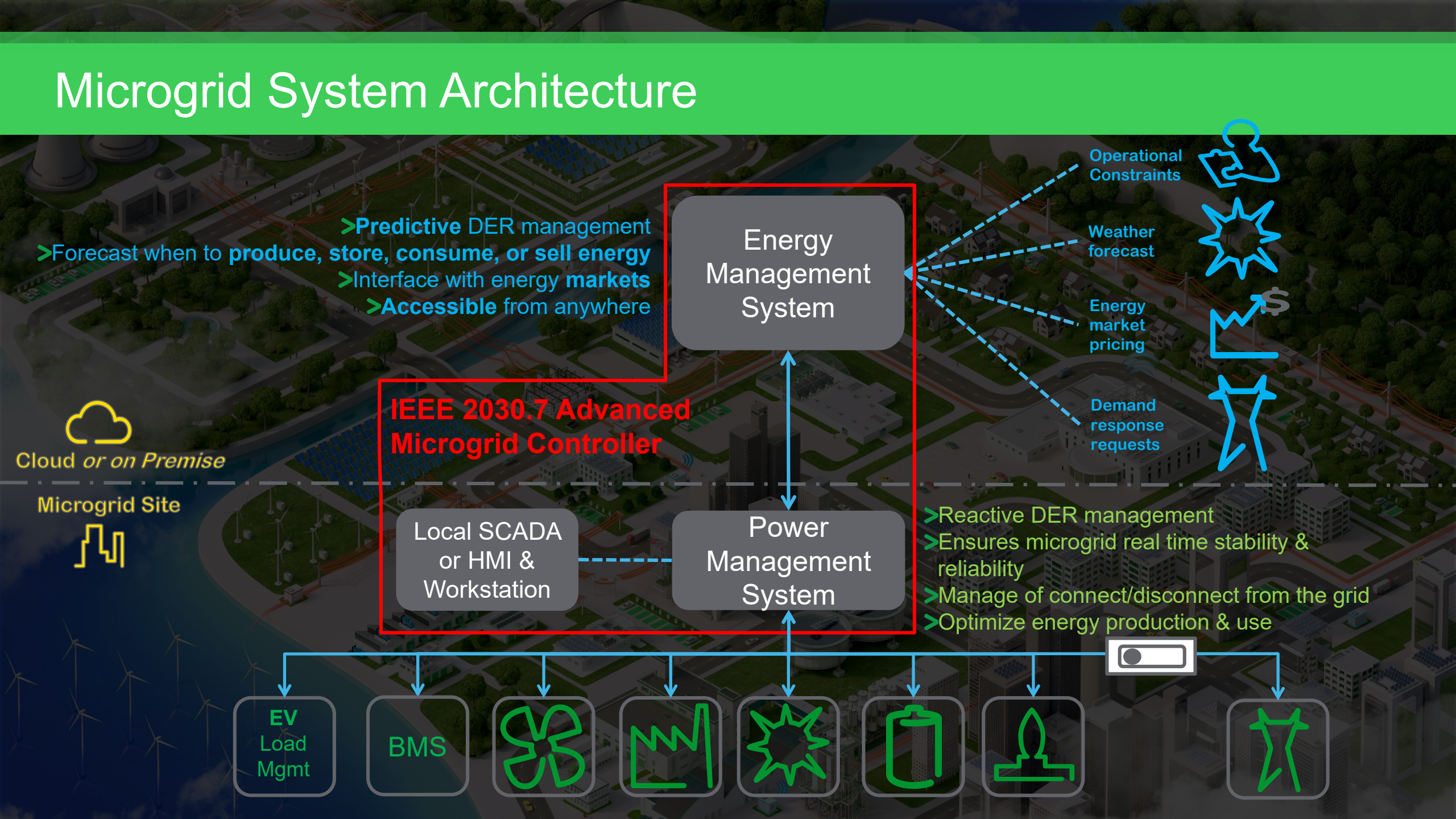


- Resiliency, power quality, and Prioritization
- Response times in ms - sec

Controls baked into many subcomponents like circuit breakers, inverters, protective relays, genset controllers, etc.

- Protection, Data collection, and Safety
- Sub second response times

Microgrid System Architecture



Key Features of the Best Microgrid Controls

- Technology agnostic & DER agnostic
- Opensource industry standard communication protocols
- API integration to 3rd party platforms
- Connectivity with 3rd party SCADA / DMS enabled
- Dedicated HMI / SCADAs
- Cybersecurity built in (IEC62443-4-2 and IEC/ISA 62443-3-3)
- Up to 100% renewable energy penetration
- Modular & Scalable
- Forecasting & AI capabilities
- Dynamic & autonomous functionality

EVauto
fleet charging control system

OCPP Local Control

Integrating Fleet and Facility Energy Planning

SUSTAINABLE FLEET TECHNOLOGY
CONFERENCE & EXPO 2023

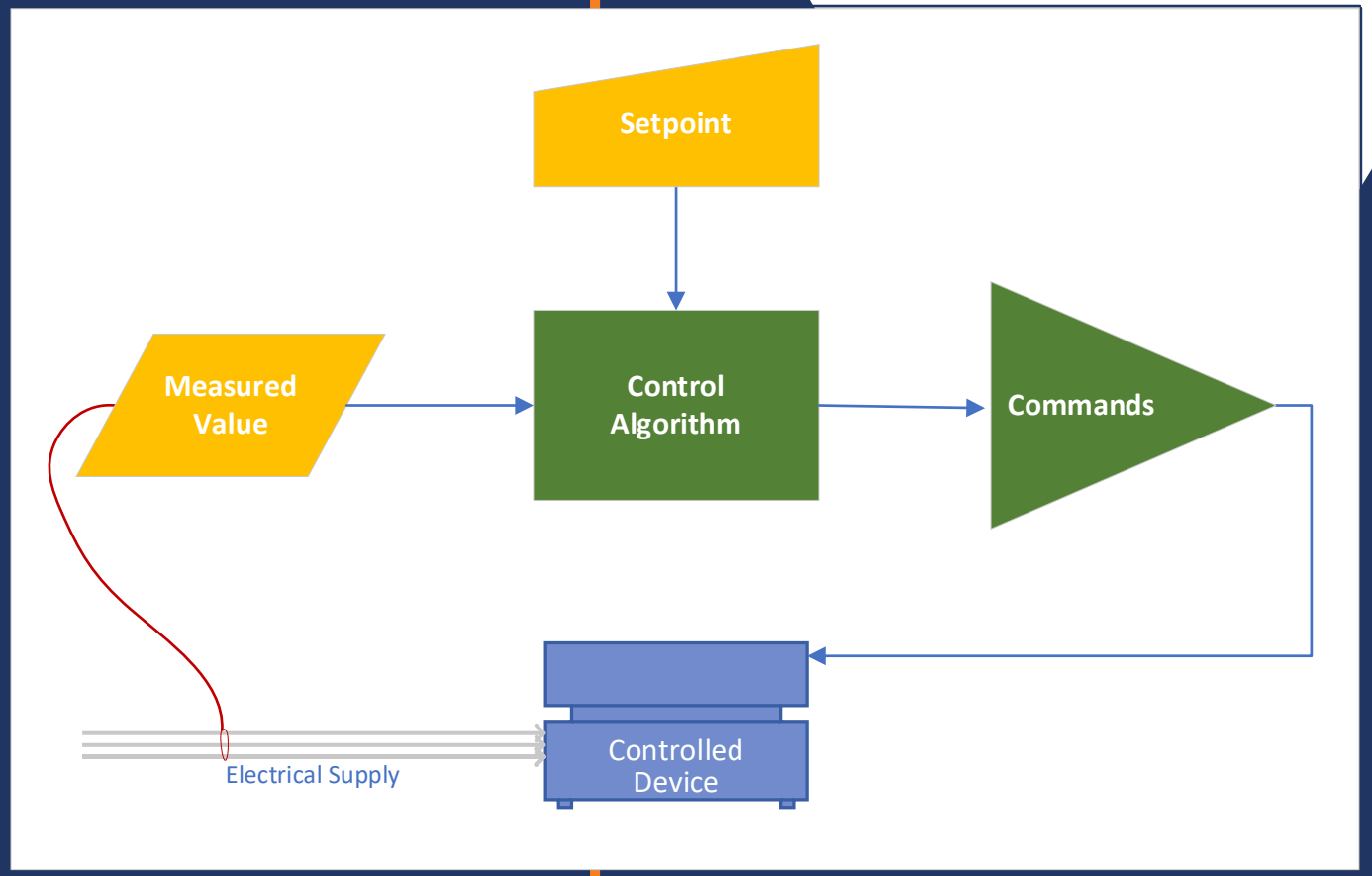
August 16, 2023

Andy Abrams

https://evauto.us/

Control 101

- Measured Value
  - What you want to control
  - i.e. AC Utility Meter
  - EV, Fleet, Facility, Microgrid
- Setpoint
  - Desired metered value
  - i.e. Demand, TOU, DR, Onsite generation / storage
- Control Algorithm
  - Compares inputs to calculate output to derive setpoints
- Commands
  - Change operation of system
  - OCPP



https://evauto.u

OCPP Local Control

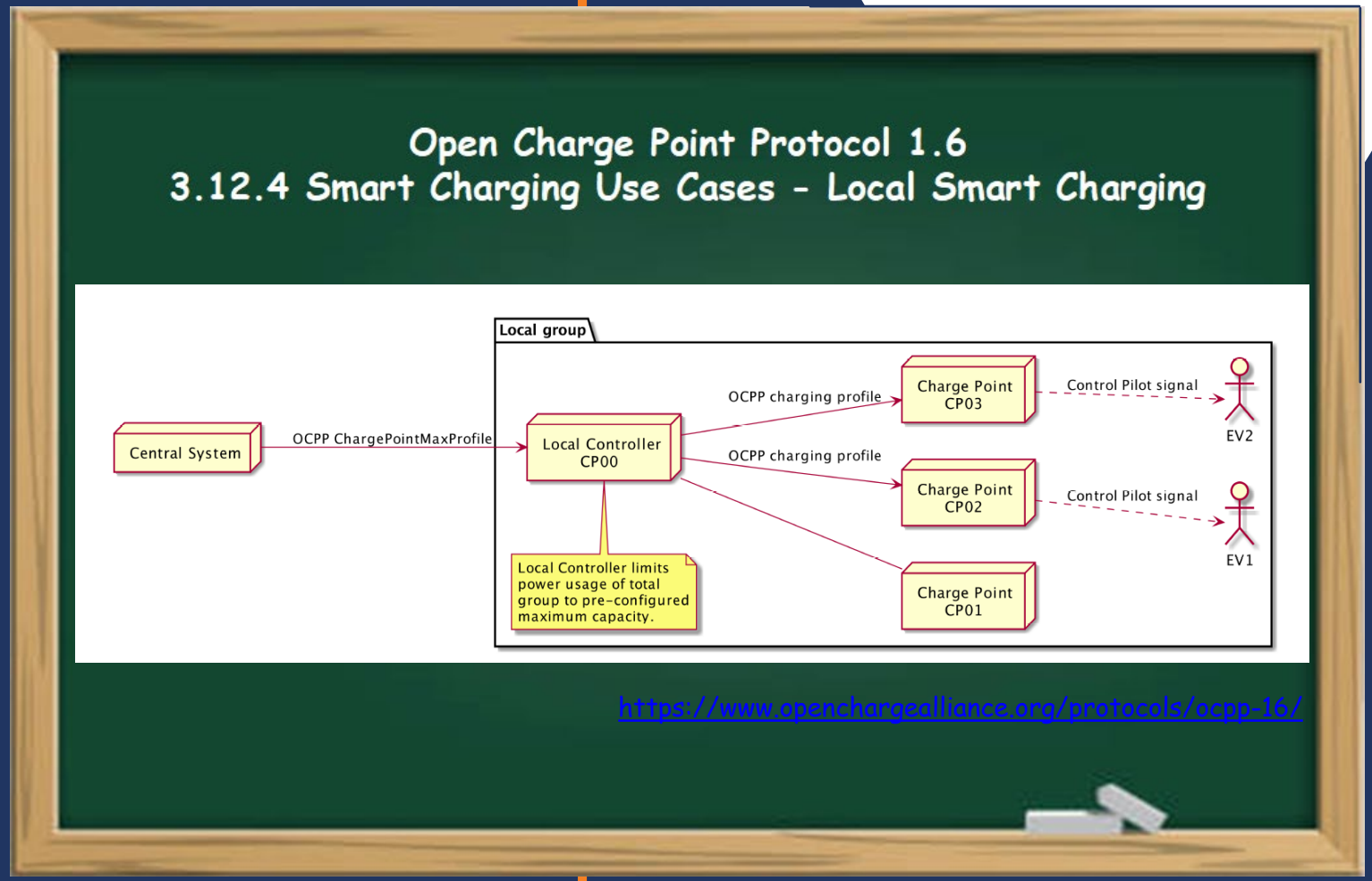
EVauto
fleet charging control system

From OCPP 1.6-j standard:

- Installed at Charging Station
- All chargers connect via Local Control to Central System
- Authentication by Central System and energy management by Local Controller

Use Cases:

- Limit charging power to one or more chargers to match available power
- Enable DSO to control charging power



https://evauto.u

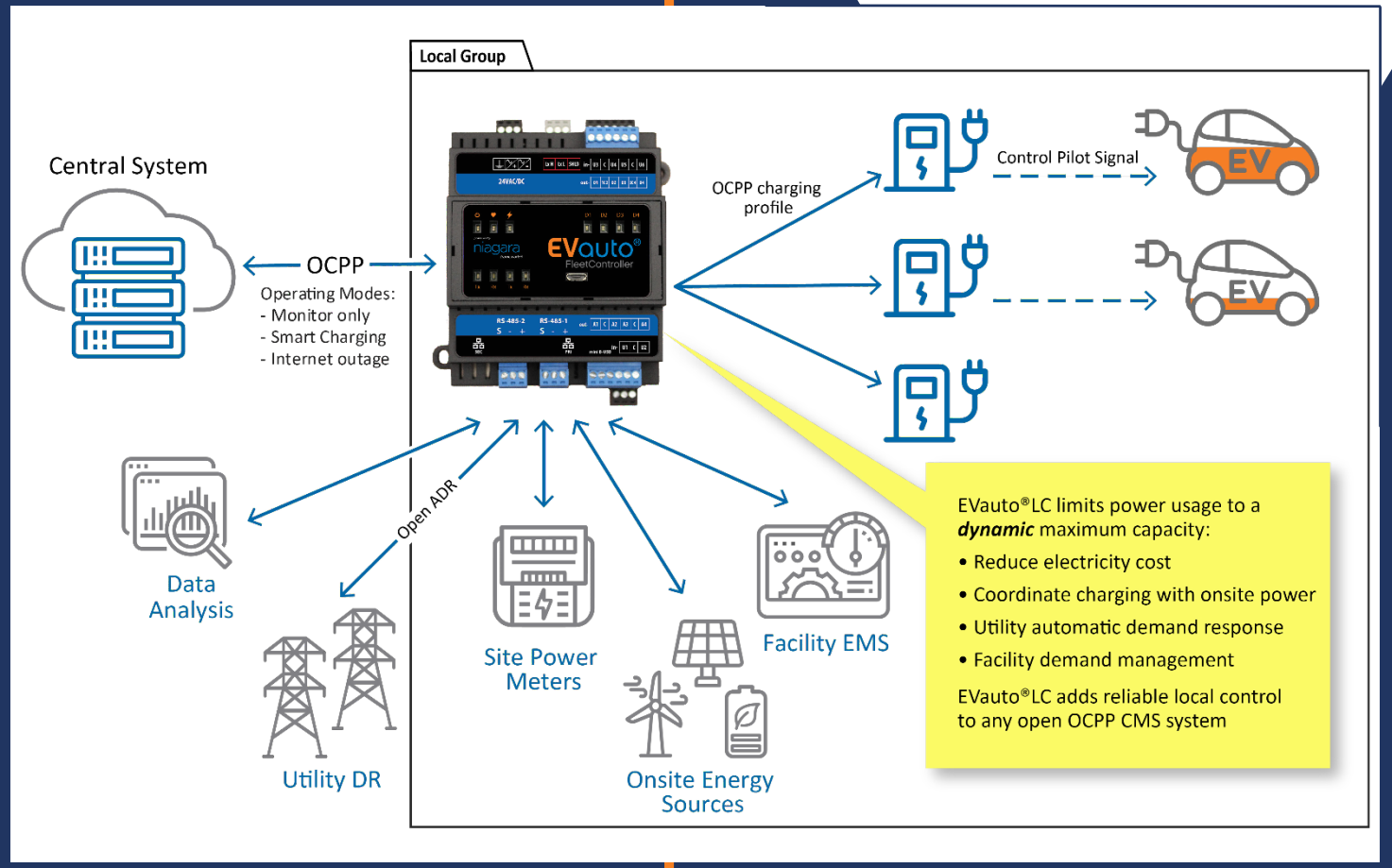
Interoperable Energy Control

EVauto®LC
OCPP Local Control

Use Cases
- EMS integration
- EV Demand and TOU Management
- Utility DR - Entire facility
- Microgrid integration
- Internet Outage

Operating Modes
- OCPP Pass-thru - Monitoring only
- Pass-thru all but Smart Charging
- Pass thru unless Internet outage

Delivers
- Lower electricity bills
- Microgrid integration
- Offline operation / cost control
- Adds Smart Charging to any CSO (unless it's locked)



https://evauto.u

EVauto®
fleet charging control system

Andy Abrams
Principal Consultant

(770) 559-1668
andy.abrams@evauto.us

230 Hammond Drive
Suite G #28822
Atlanta, GA 30328-9997

Brookville Microgrid Tour

Ahron Berney , Fleet Management Services

Department of General Services

Site Overview

- Represents an example of an old facility retrofitted to support bus electrification.
- Strategic Location
  - Proximity to downtown Silver Spring
  - Location in conjunction with new Purple Line Project
- Facility Capacity
  - 140 Buses
  - 11 Shop Bays
  - Bus Body Shop

Project Overview

Build a microgrid capable of supporting the County's transition to zero emissions while performing day to day transit operations.

Maximize solar

Minimize noise

Address light pollution

Provide enough resiliency to support the County's emergency bus service.

Provide bus charging

Operate and Maintain the microgrid, chargers, and supporting infrastructure.

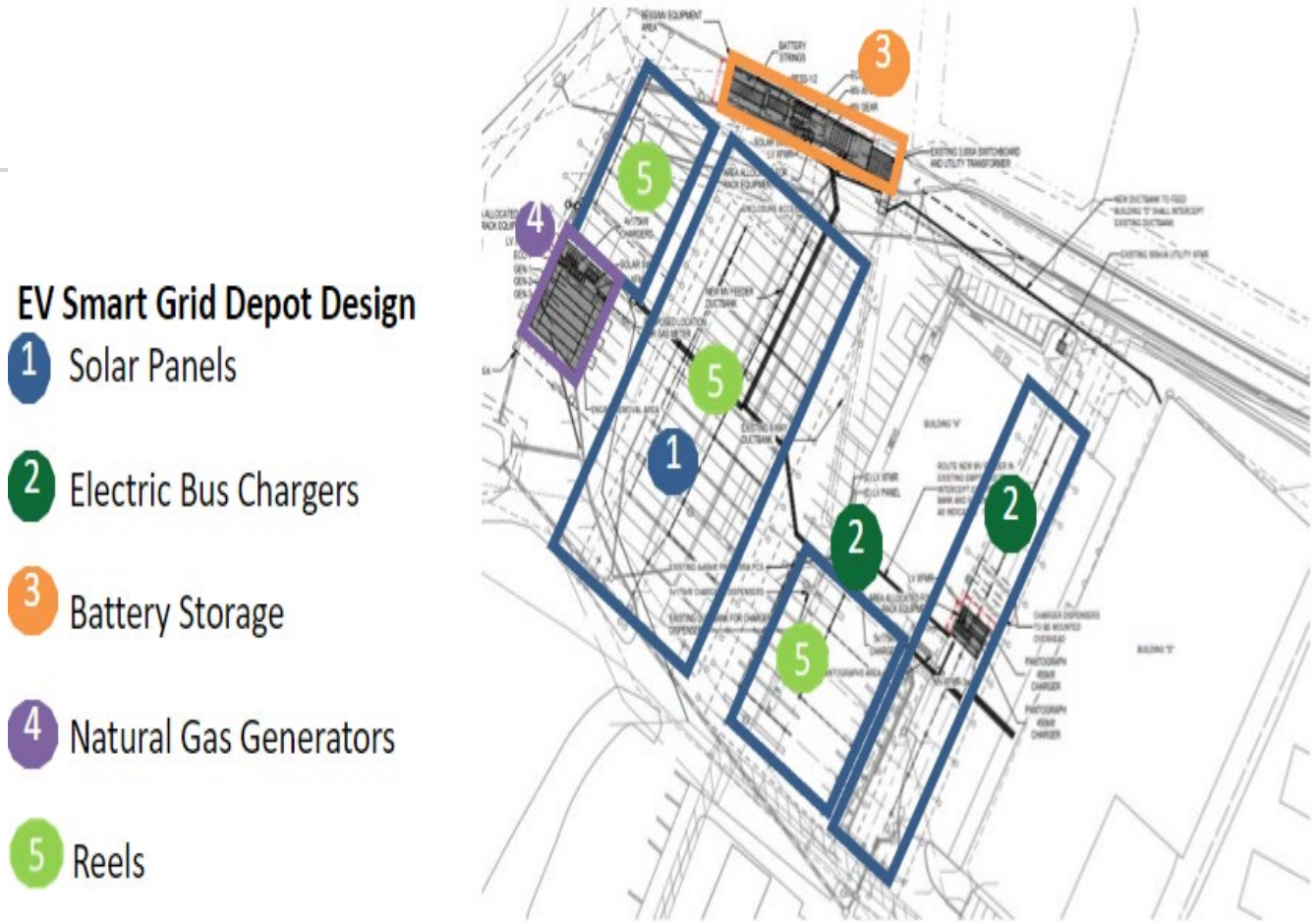
Flexible funding strategies.

Selected Partner

- AlphastruXure
  - Charging-as-a-Service
  - They own, provide design and construction, project management, operate, and maintain
  - The County pays a per kw fee that includes the capital and operating costs.
  - Provides 24/7 monitoring of site
- Track Record of Success
  - County's Public Safety Headquartes
  - One of the first EaaS migrogid projects globally
  - Awarded PEER Planimum Certification for excellence in design and operations.

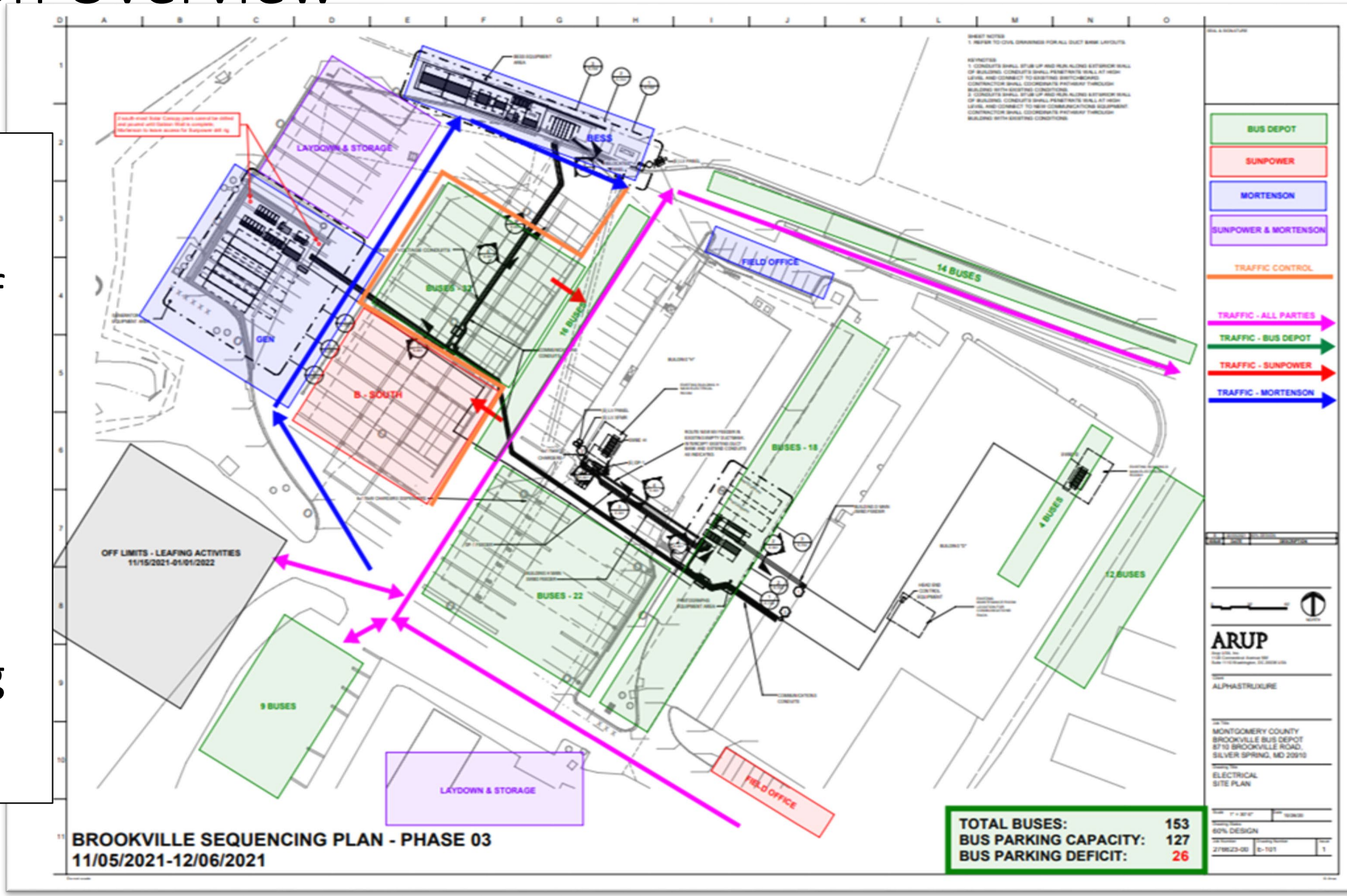
Brookville Microgrid Specifications

- Solar
  - 2 MW- Maximum allowed on premises by the State
  - 17’ Canopies- To ensure the clearance of towed buses.
- Power Generation
  - (3) 600 KW Natural Gas Generators
- Battery Energy Storage (BESS)
  - 4.3 MW
- Chargers
  - (22) Chargers (4) Proterra, (18) Heliox 180 kw Flex chargers
  - (55) Dispensers- (51) Overhead Reels and (4) ground-mount
  - 2 Heliox 450 kw Pantographs
- Charge Management
  - The Mobility House



Construction Overview

- 23 Phases of Construction
- 4 Major areas of construction
- 3 Major Contractors
- Multiple traffic patters
- Multiple parking areas

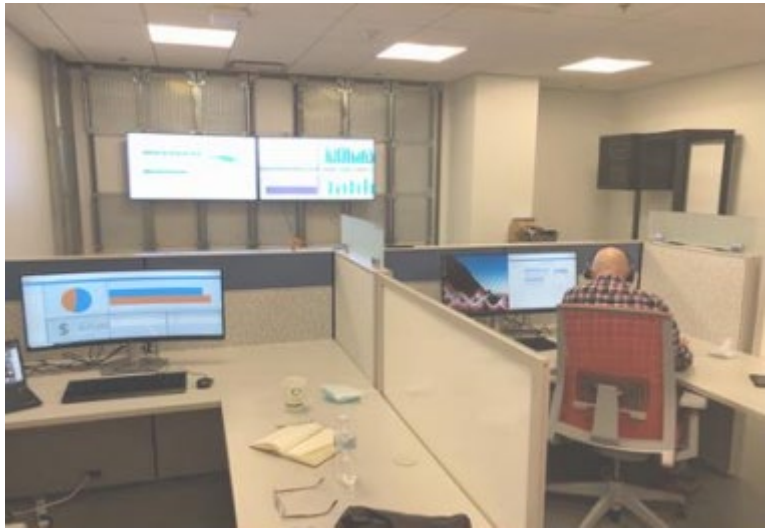


Brookville Microgrid

- 1st Phase of the project opened October 31, 2022
  - Installed all of the solar and batter storage specified in the project.
  - Installed charging under Canopy C.
  - Installed 1 pantograph charger under Canopy D.
  - Installed 1 of 3 600 KW generators
- 2nd Phase near completion
  - Construction is complete
  - Awaiting Commissioning

Operations & Maintenance

- Billing & reoccurring reports
- Developed ERP workflow
- EV Bus Charger Software Interoperability
- Customer Portal management
- NOC Operator



AlphaStruxure

AlphaStruxure, LLC.
A Carlyle Group and Schneider Electric Company
201 Washington Street, 27th Floor
Boston, MA 02108

Bill To:
Montgomery County Brookville Bus Depot

Invoice Date: 09/10/2020
Invoice Number: #####-#####
Invoice Due Date: 10/09/2020

Account Activity

08/01/2020 thru 08/31/2020	Volume	Dollars
Energy	##,###.## kWh	$ #,###.##
Capacity	##,###.## kW	$ #,###.##
Other	##,###.## /month	$ #,###.##
Total New Charges		$##,###.##

Balance Due Current	$ ##,###.##
Outstanding Balance	$ ##,###.##
Total Due	$ ##,###.##

Notes:

Meter Number	Read Start	Read End	Quantity	UOM
######	08/01/2020	08/31/2020	##,###	kWh

Monthly Usage Chart (kWh and $/kWh)

Payment Instructions

Make Checks Payable to:

AlphaStruxure, LLC.
A Carlyle Group and Schneider Electric Company
201 Washington Street, 27th Fl.
Boston, MA 02108

Wire/ACH:

ABC Bank
ABA: #########
Account: ##########
Ref: ######

Contact Information

Billing: Acctspayable.xxx@se.com

System Support: AlphaStruxure@se.com

Operations and Maintenance - Service providers

Schneider Electric

Field Project Management Services

SUNPOWER Solar PV System

heliox EV Chargers

THE MOBILITY HOUSE Charge Management System

AB Natural Gas Generators

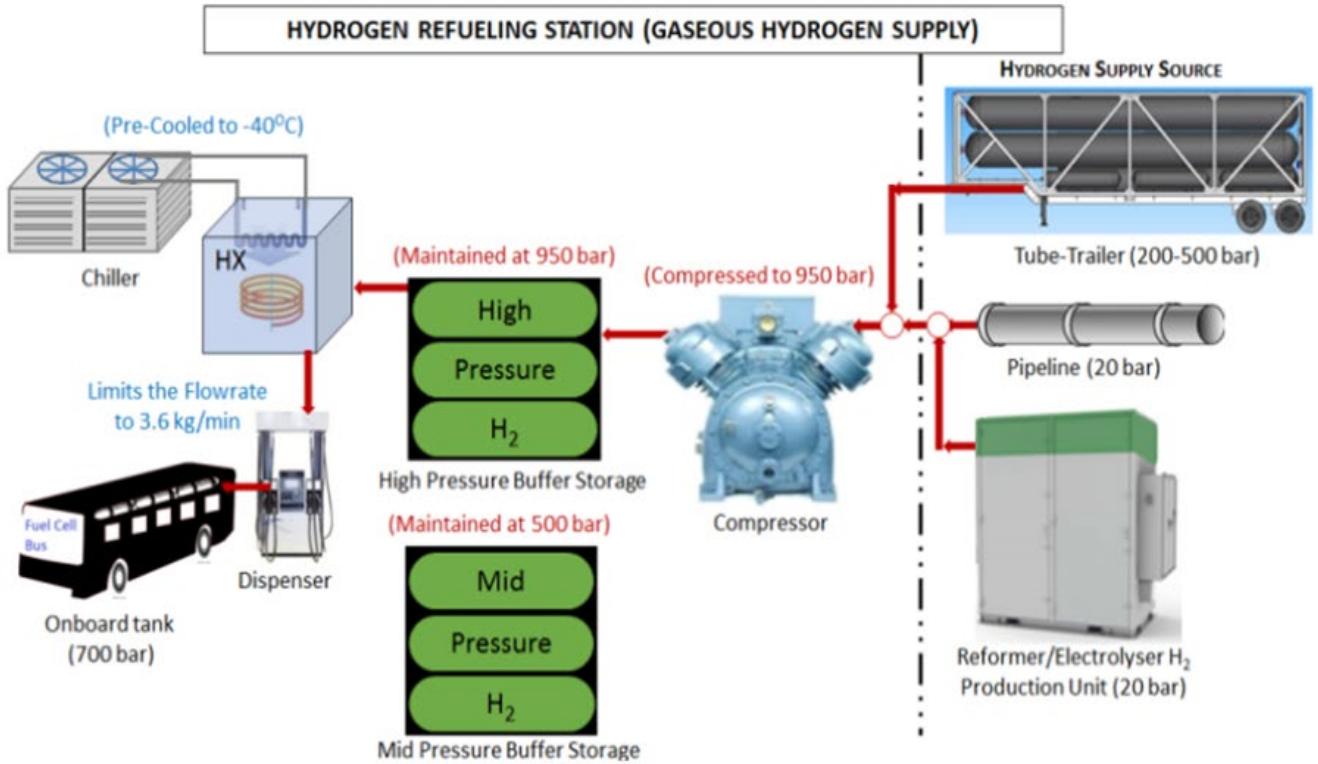
DYNAPOWER POWERING A CLEANER PLANET Battery Energy Storage System

Fuel Cell Project

Awarded 2022 FTA Low/No Emissions Grant to procure and operate 13 fuel cell buses and the associated equipment and infrastructure to create and dispense “Green Hydrogen” produced through electrolysis.

Project Highlights

- Grant award $28.62 Mil
  - Includes the purchase of 13 fuel cell electric buses.
  - Hydrogen fueling station and electrolyzer
  - Facility upgrades to support fuel cell buses
  - Training and workforce development.
- Displaces over 140,000 gallons of fuel annually; Reduces emissions by 2,000 metric tons
- First project of its kind on the East Coast
- Includes a parallel (P3) project to construct a microgrid to provide the power to produce hydrogen, power dispensing equipment, add electrical capacity to support electric buses and provide operational resiliency.



Schematic representation of gaseous hydrogen refueling station configurations

EMTOC Microgrid

Phase I Design

- Over 5MW of Solar

- 900KW BESS

- 4.5MW of Charging Capacity

- Mix of CCS1 and Pantograph charging.
  - Interest in inductive charging however uniformed standards not adopted.

- Creates green hydrogen to support 1MW Electrolyzer.

Calvin Jones

240-876-4578

Calvin.jones@montgomerycountymd.gov

Questions

THE MOBILITY HOUSE

Automated Load Management

Elizabeth Hughes

What is it?

"Automated Load Management (ALM) is the use of software or other behind-the-meter technologies to strategically share charging capacity across multiple charging ports at the same charging site, helping safely connect multiple charging ports whose total nameplate load would otherwise exceed the rated capacity of the customer connection. By using ALM, customers can avoid or defer the need to upgrade certain distribution system infrastructure to accommodate the new EV charging load."

- Definition from the Vehicle-Grid Integration Council (VGIC)

Controlling The Flow

- Water = Electrical load/Power
- Dam = Site-level Breaker
- Reservoir = Total Name Plate EVSE Load
- Damage from overflow = Consequences from allowing the flow to exceed the EMS Setpoint
- Spillway = ALM Capable System

A spillway is a designed structure in a dam that allows controlled releases of water when the water level in the reservoir exceeds a certain threshold. It helps regulate the flow downstream, preventing the dam from overflowing and potentially causing damage to the dam and surrounding areas.

Grid Upgrades

Can cost you

1+ Years [1]

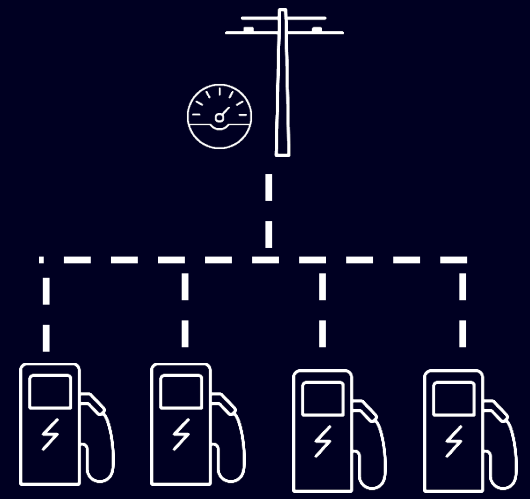
&

$500K+ [2]

1 https://energycenter.org/thought-leadership/blog/ev-market-slowed- utility-data-disconnect

2 TMH Anonymized Site Actualized Savings

Example Site



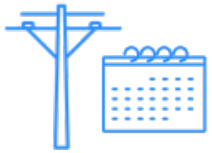
- 4 - 150 KW Chargers
- 500 Kw transformer

4* 150 KW = 600 KW of Load
Rated to 80% = 400 KW of space

400 KW If Space > 600 KW of New Load

Alternatives To ALM

If ALM is not integrated into the planning process, there are generally three options for the design of electrical infrastructure, each with varying degrees of added **project expense, delay, or downsizing.**



Wait and Pay for a Grid Upgrade

Time and cost depend on the size of the grid upgrade.

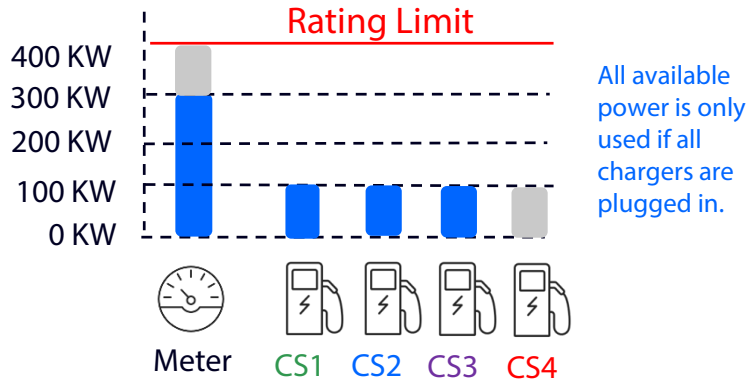
Install fewer chargers

Total Nameplate EVSE Power
< Existing Power

Affect operations, possibly requiring physical movement of vehicles.

Derate the chargers

EVSEs will always be restricted to a fixed max power. This amount typically is split evenly between all chargers.



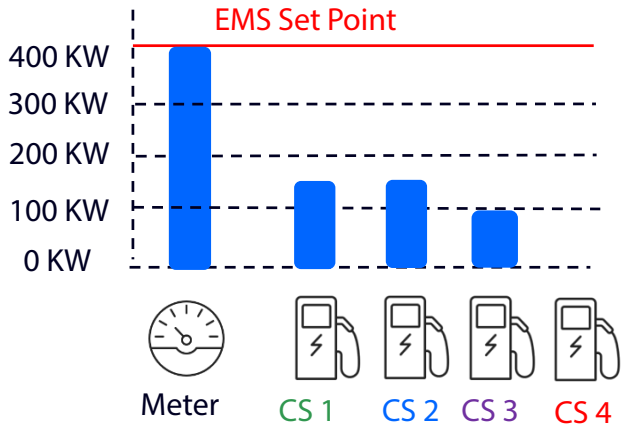
With ALM

You Can:

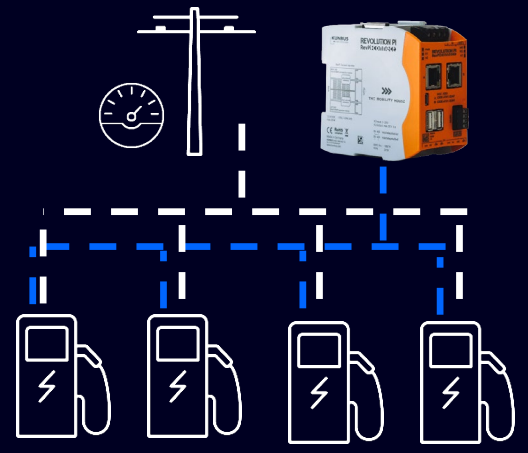
Avoid, Reduce or Prolong Grid Upgrades

If You:

- ❑ **Talk with your AHJ, Electrical Contractor & Utility (Necessary)**
- ❑ **Run Simulations (Highly Recommended)**



Space on connection -- > EMS Set Point



All Chargers installed &
No Upgrade Required

National Electric Code

Why

A set of requirements for the design, installation and operation.

What

Covers

- Electrical Connections
- Grounding
- Circuit protection
- **Equipment Rating**

Who & Where

2020 NEC® - 28 2017 NEC® - 15
2014 NEC® - 1 2008 NEC® - 2

County/Municipality NEC ® regulations only - 4

When

NEC Version & Terminology	
ALM	EMS
2014	2023
2017	
2020	

How

Contact your local Authority Having Jurisdiction and Utility

Equipment Rating

X

=

Max Load

125%

Equipment Size

EMS Setpoint

Circuit Breaker Rating

Cost Reduction

Source: The Mobility House

Irish Post

Over 100
Depots

2,900+
Chargers

No Grid Upgrade

ALM
Integrated

Challenge

Highest requirements for charging management, fault monitoring, and reliability

Avoided grid
Upgrade of 50 MW

~$500,000 / year
In energy charges and capital costs

Industry
National Postal Service

Region
Ireland

Charging Stations

2,800 22 kW AC & 180 25-50 kW DC

Energy Management
ChargePilot®

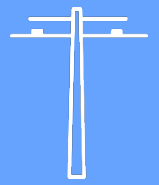
Areas of Focus
Load Management (ALM)

Bring it All Together

ALM regulates the amount of power below a safe limit

Help install EV sites by avoiding, reducing or prolonging the need for a grid upgrade

Affects the sizing of equipment needed and therefore affects permitting



Talk to your AHJ, Electrical Contractor, Utility and CMS provider ahead of time

THE MOBILITY HOUSE

Thank you!

Elizabeth Hughes

elizabeth.hughes@mobilityhouse.com

The Mobility House

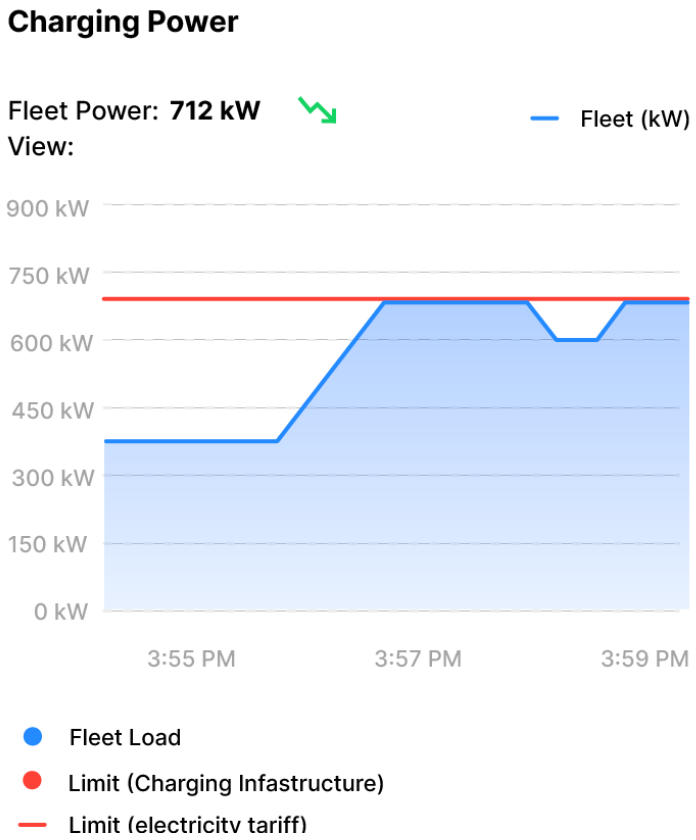
545 Harbor Blvd.

Belmont, CA

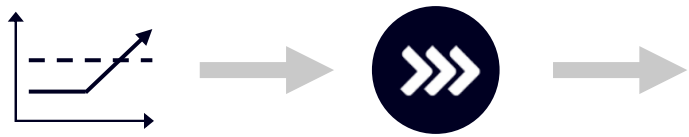
References in NEC 2023 for EV- related infrastructure sizing equipment

Type of Equipment	Load Calculation Without ALM	Load Calculation With ALM
Service Conductors	125% of Nameplate Load	EMS Set Point * 125%
Overcurrent protection devices (branch and feeder)	125% of Nameplate Load	EMS Set Point * 125%
Distribution Transformer	Nameplate Capacity * Safety Factor (not determined by NEC)	EMS Set Point * Safety Factor (not determined by NEC)
Service Equipment	Sum of Load on Branch circuit	EMS Set Point * 125%

ChargePilot's Proven ALM Ability



Dynamic Site Load Adjustment Process



1. Load on-site increases (due Vehicle Plug-In)
2. ChargePilot identifies peak & runs new optimization

3. Charging stations receive new power offer & send it to EVs
4. EVs adapts charging power to newly set maximum
5. Total Site Load is kept at or below Grid Limit