Electric Vehicle Charging Infrastructure

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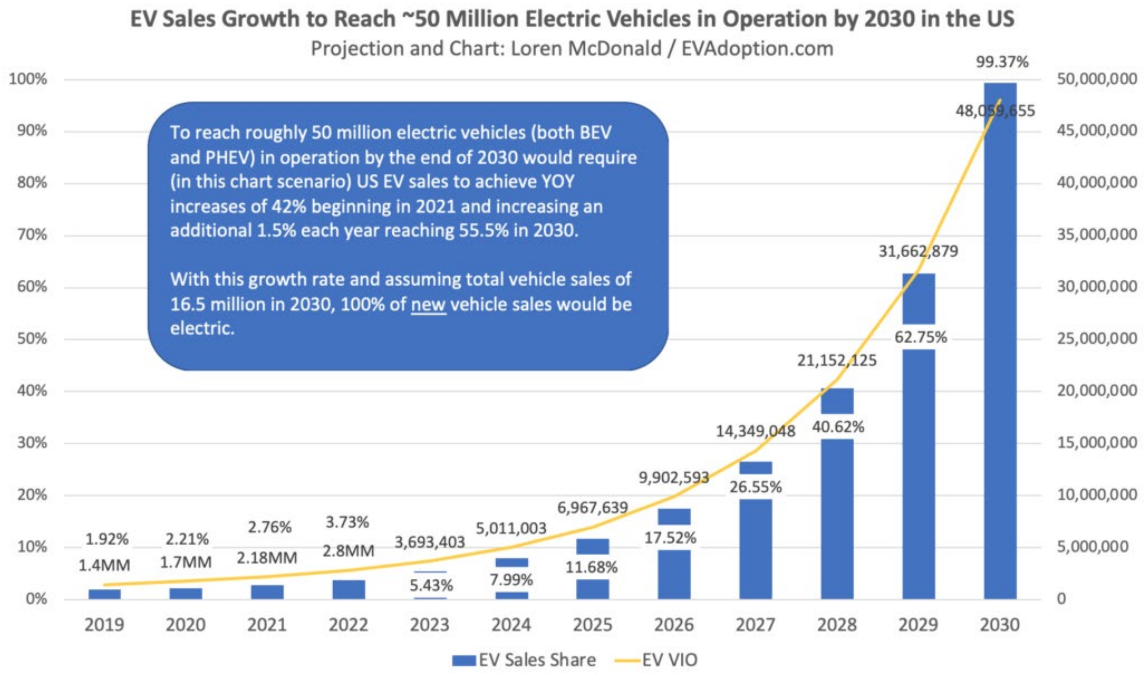
Agenda

- Electric Vehicle (EV) background
- EV Charging Types
- EV Charging and Facility Power
- EV Charging Costs and Incentives
- Open Discussion

Coming Wave of Electric Vehicles

- Federal target is for half of new passenger cars and light trucks sold in 2030 to be zero emission vehicles (battery electric, hybrid, or hydrogen)
  - Recent proposals from the Biden administration on automobile pollution limits may accelerate that to as much as 2/3 of new vehicles sold in 2032 to be electric
  - For medium duty trucks, target is ~50% of new vehicles sold in 2032
- Certain states are accelerating mandating this even faster
  - California has a target that by 2035, 100% of new cars and light trucks sold in CA will be zero emission vehicles



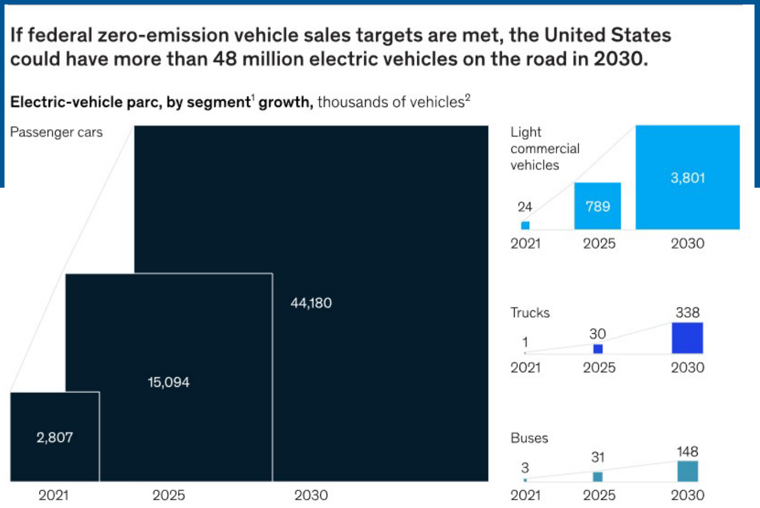
https://fortune.com/2023/04/12/new-biden-administration-epa-pollution-rules-require-10x-ev-sales-2032/

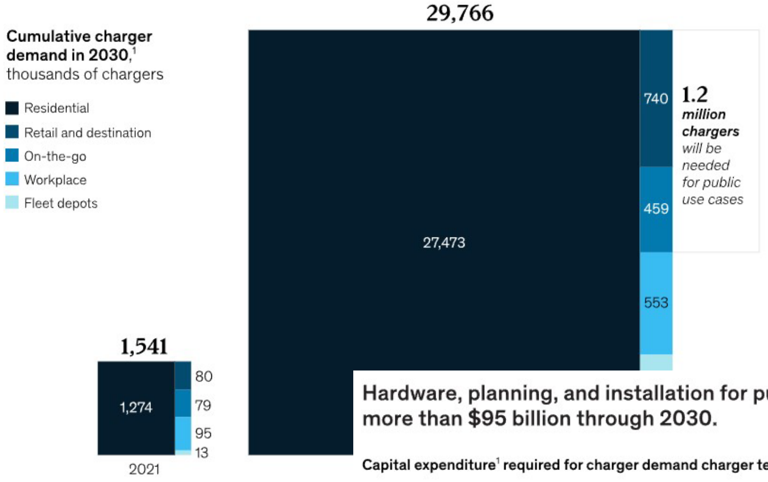
https://ww2.arb.ca.gov/news/california-moves-accelerate-100-new-zero-emission-vehicle-sales-2035

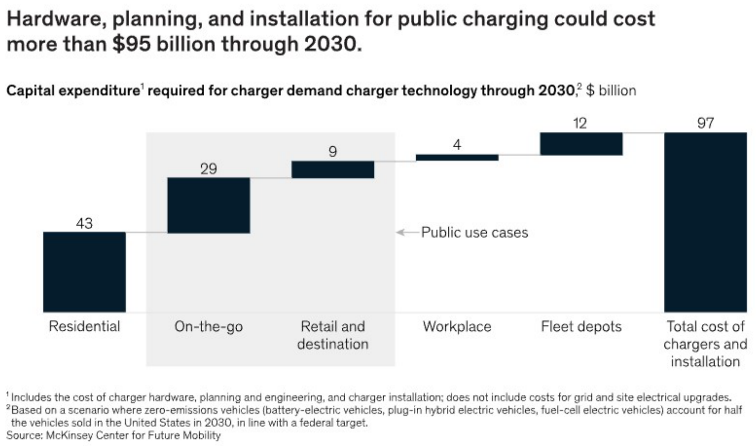
Electric Vehicles and Electrical Demand

- As the number of EVs on the road increases, electricity demand is expected to surge from current **11B kWh** to **230B kWh** in 2030;
  - 230B kWh represents ~5% of the current total electricity demand in the US
- McKinsey estimates over $95B of EV charging investment through 2030 to provide over 1.2M new public charging locations

Source: https://www.mckinsey.com/industries/public-and-social-sector/our-insights/building-the-electric-vehicle-charging-infrastructure-america-needs

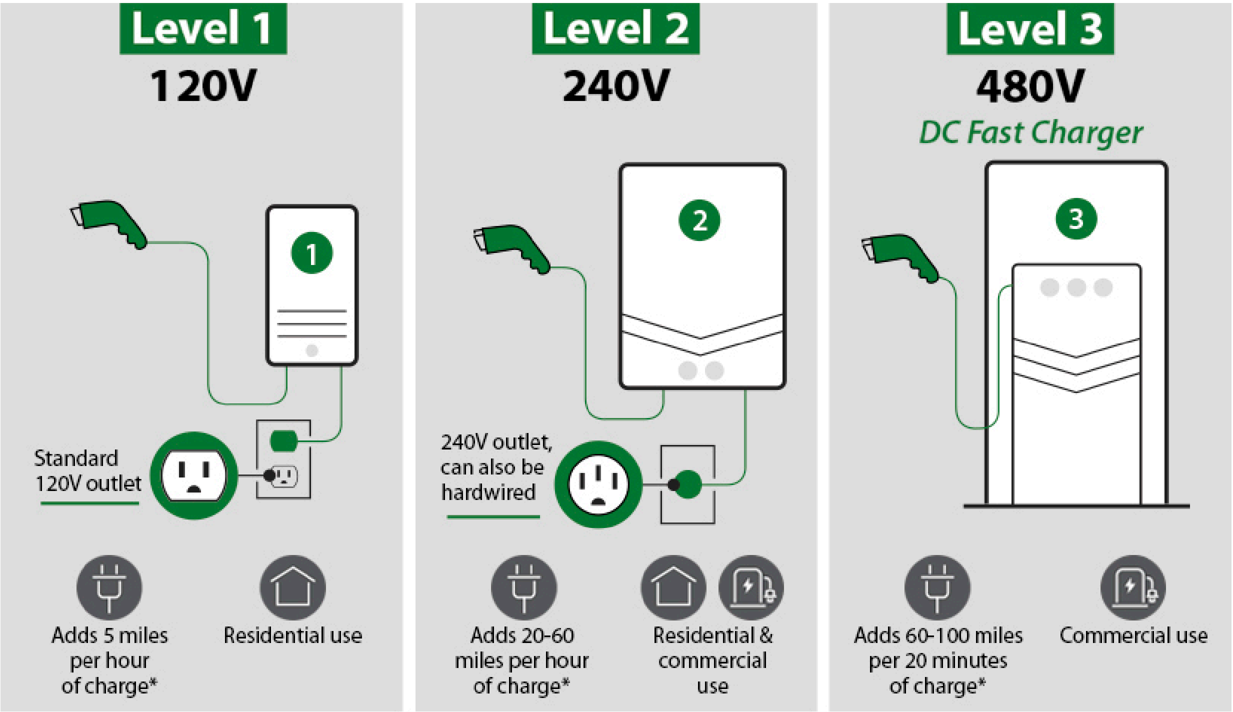




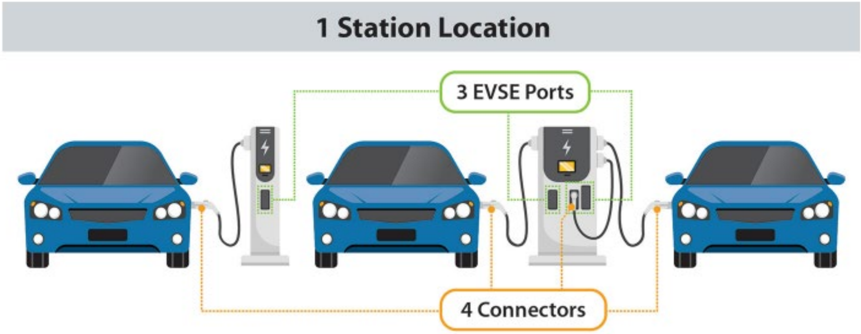


Types of EV Chargers

- Charging equipment for PEVs is classified by the rate at which the batteries are charged.
- Charging times vary based on how depleted the battery is, how much energy it holds, the type of battery, and the type of charging equipment (e.g., charging level and power output). The charging time can range from less than 20 minutes to 20 hours or more, depending on these factors. Charging the growing number of PEVs in use requires a robust network of stations for both consumers and fleets.

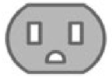


* Estimated. Actual charge times may vary.



Source: https://afdc.energy.gov/fuels/electricity_infrastructure.html

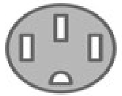
EV Charger Hardware Levels



Level 1

120V

15-20 AMPS



Level 2

240V

UP TO 80 AMPS

Level 3

480V

300 AMPS

Single Port

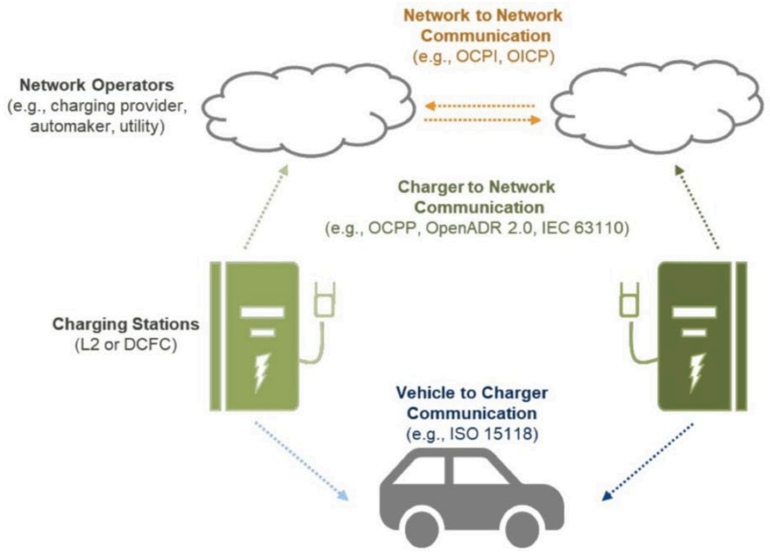
Dual Port

Increasing equipment and installation cost

Commercial EV Charging Components

- Core charger equipment (including dispenser) from multiple suppliers
- Onboard user interface enables interaction with charger
- Network software can be a separate supplier using open protocols (OCPP)
- Use case of the charger dictates the type of software deployed:
  - Public-facing EV charger with revenue collection often utilizes cloud-based software with app and credit card capabilities
  - Private/fleet focused EV charging can utilize less expensive software with RFID or other access controls
- Software also used for facility monitoring and proactive maintenance

AC Charging Station



How Does Charging Work

- Where vehicles are charged affects the type of deployment
- For passenger vehicles, longer “dwell time” enables lower power (level 2) chargers:
  - E.g., home charging overnight (8+ hours) or workplace charging (during workday) using level 2
- For long distance trips, rapid recharging (aka the gas station model) is needed with level 3 chargers
- Considerations for urban areas, apartment, etc. can shift more of this to workplace charging if there is limited access at home (no garage or common area EV charging)
- Similarly for fleet vehicles, the usage profile varies:
  - Overnight recharge with level 2
  - Mid-day recharge with level 3

How are EV chargers installed

- Home: Level 2 chargers
  - Level 2 utilizes 208/240 Vac (aka electric dryer sized connection), generally requires an electrician to install
- Commercial Level 2 chargers
  - Utilize multiple 208/240 Vac connections
  - Each level 2 dispenser can draw up to 20 kW of power
  - Small level 2 deployments (e.g., 6 chargers) can often be handled within existing facility electrical infrastructure; larger deployment may require electrical infrastructure upgrades

- Commercial Level 3 chargers
  - Utilize 480 Vac connection
  - Multiple level 3 variants with peak power of 50 to 350 kW of power
  - Deployments typically require some level of facility electrical infrastructure upgrade and/or dedicated utility service points
- Commercial deployments are generally in parking lots which require both electrical work as well as civil work (including directional boring and bollard placement, etc.)

EV Charger Considerations

Charging Level	Vehicle Range Added per Charging Time and Power	Supply Power
AC Level 1	4 mi/hour @ 1.4kW 6 mi/hour @ 1.9kW	120VAC/20A *(12-16A continuous)*
AC Level 2	10 mi/hour @ 3.4kW 20 mi/hour @ 6.6kW 60 mi/hour @ 19.2 kW	208/240VAC/20-100A *(16-80A continuous)*
DC Fast Charging	24 mi/20minutes @24kW 50 mi/20minutes @50kW 90 mi/20minutes @90kW	208/480VAC 3-phase *(input current proportional to output power; ~20-400A AC)*

Some common add-ons to plug-in vehicles include electric vehicle supply equipment (EVSE), chargers, and software.

Chargers

Software

Other Equipment

Find an EV Charging Station

Battery Surveys

https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf

The costs associated with owning and operating EVSE include:

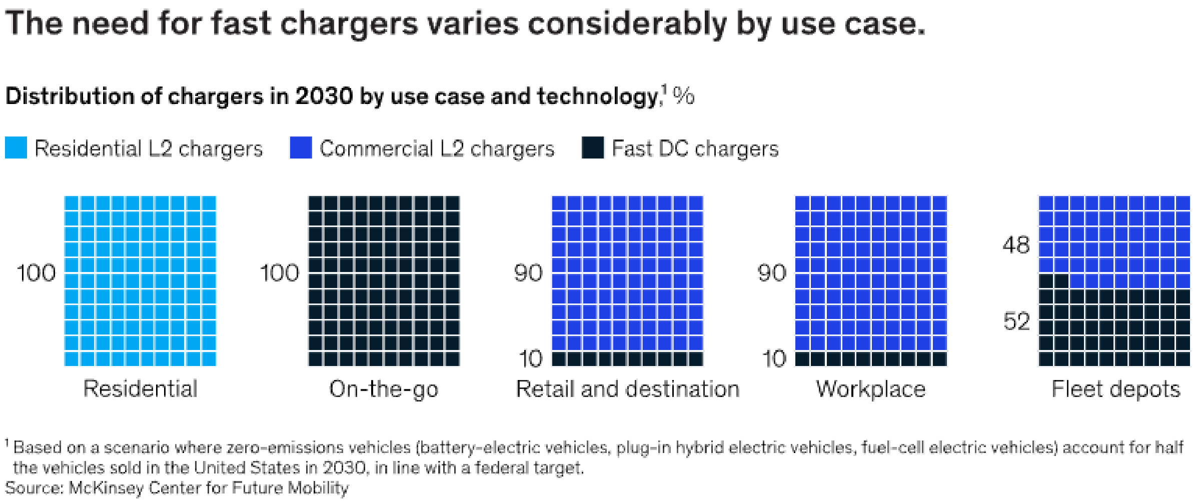
- EVSE unit hardware cost, which may include:
  - EVSE unit
  - optional EVSE equipment (e.g., RFID card reader);
- Installation cost, which may include:
  - contractor labor and materials for
    - connecting EVSE to the electrical service (e.g., panel work, trenching/boring, and repaving parking)
    - new electrical service or upgrades (e.g., transformers)
    - meeting Americans with Disabilities Act (ADA) requirements
    - traffic protection
    - signage
    - lighting
  - permitting and inspection
  - engineering review and drawings;
- Additional capital cost, which may include:
  - hardware extended warranty
  - repair labor warranty
  - land/parking space purchase or lease;
- Incentive credits (to reduce equipment or installation costs), which may include:
  - rebates
  - tax credits/exemptions
  - grants
  - loans

Photo 2. Pedestal-mounted EVSE installed by the City of Raleigh, N.C., for free public use. *Photo from Kathy Boyer, NREL 18520*

- Operation and maintenance cost
  - electricity consumption and demand charges
  - EVSE network subscription to enable additional features
  - management time
  - billing transaction costs
  - preventative and corrective maintenance on EVSE unit
  - repairs (scheduled and unscheduled).

Level 2 and Level 3 Deployments

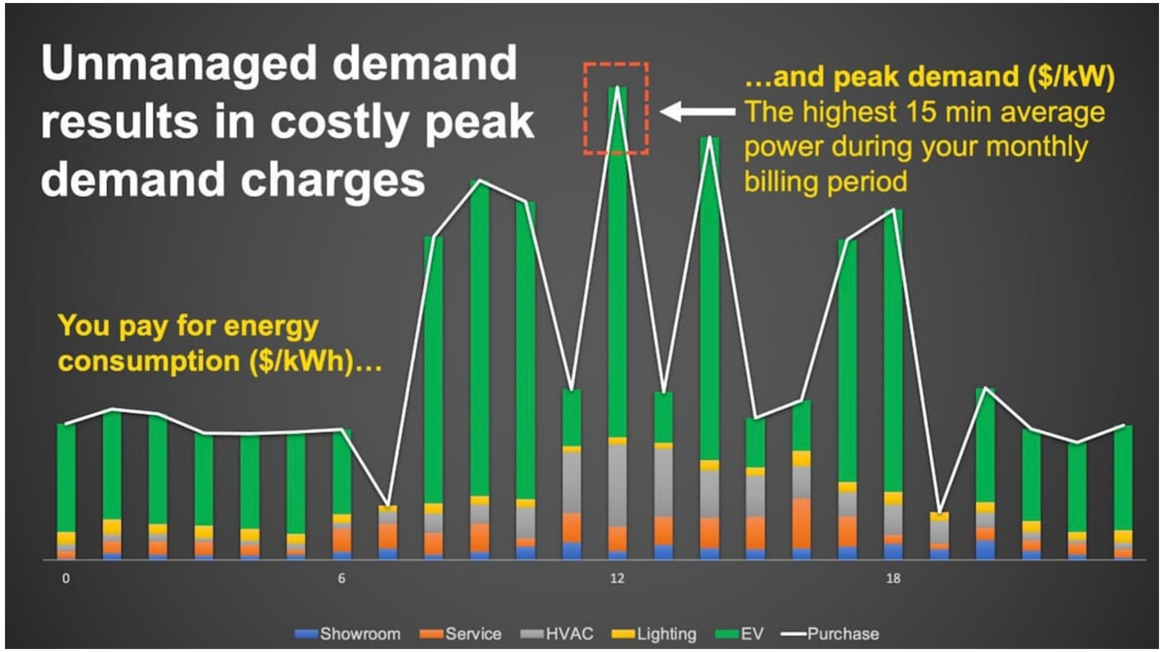
- Level 2 appropriate for longer timeline (overnight, during workday) charging
  - By 2030 will be predominantly for residential and workplace installations
- Level 3 provides faster charging
  - Best application for locations where vehicles need to be charged quickly - on-the-go and some retail/destination locations
  - Also expected to be over half of the fleet depot deployments by 2030



Source: https://www.mckinsey.com/industries/public-and-social-sector/our-insights/building-the-electric-vehicle-charging-infrastructure-america-needs

EV Chargers and Impact on Facility Power

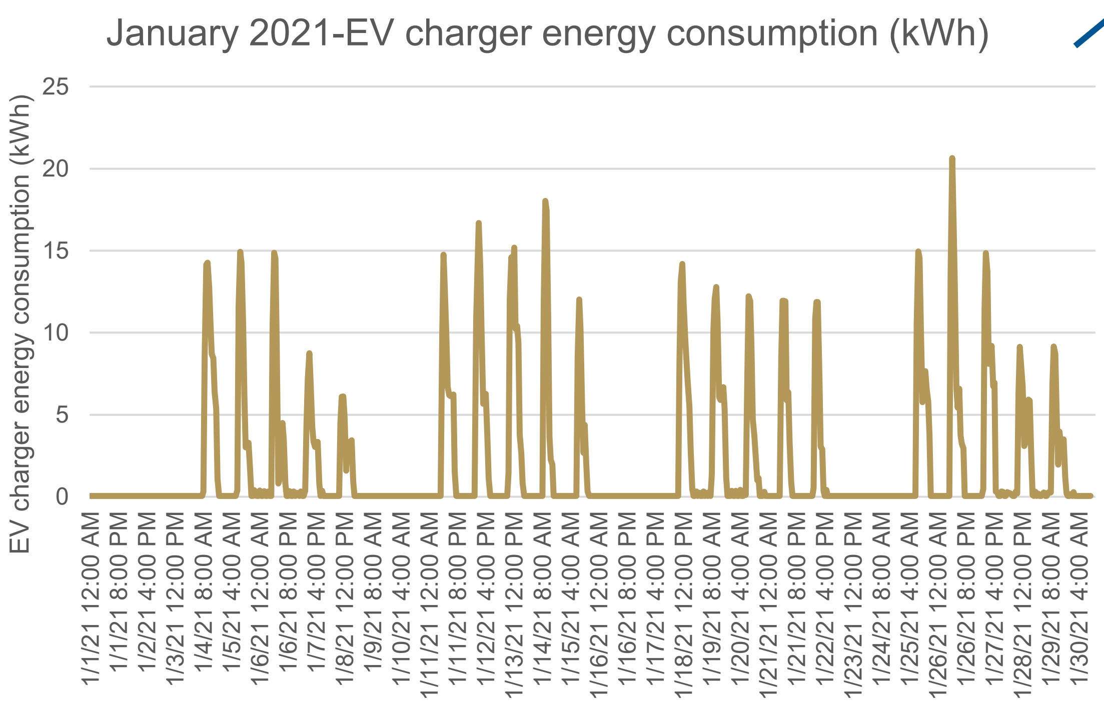
- Electricity usage is measured on:
  - Consumption (kWh): Amount of energy utilized by a facility during a billing cycle
  - Demand (kW): Peak amount of energy utilized during a billing cycle
  - Time-of-use (TOU) plans separate these out by different time periods (e.g., Weekdays noon – 5 pm for high peak period)
- Electricity costs associated with the usage depending on factors including your electric distribution company, supplier (for deregulated states), and tariff schedule
- **EV Charging can have a significant impact on both consumption and demand, with corresponding cost impacts to the host facility**

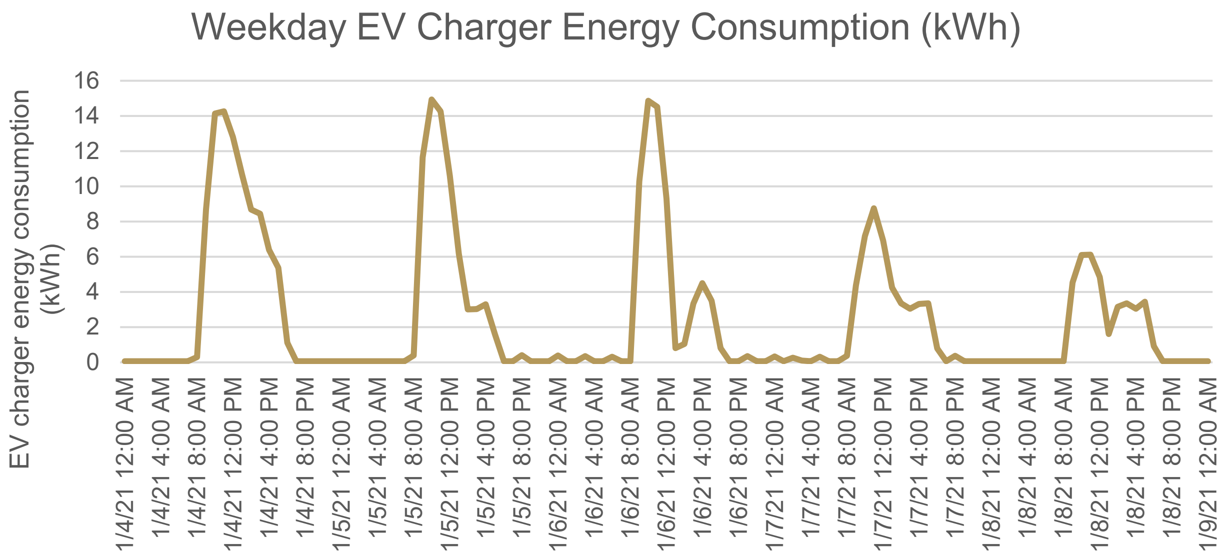


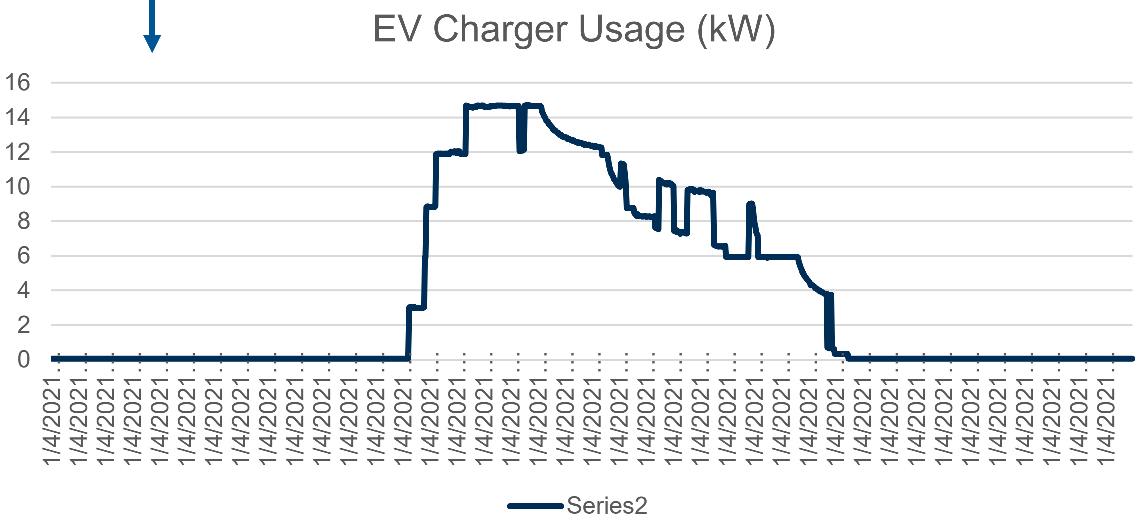
Graphic source: https://www.canarymedia.com/articles/ev-charging/helping-auto-dealers-learn-to-love-evs

EV Charging Example: Melink Corporate HQ2

- Constant 3.3 kW power draw until vehicle is fully charged







Mitigating Impact of EV Charging on Facility Power

- Utilize intelligent EV charging management systems
  - Grid-tied / grid-aware controllers to manage EV charging to mitigate demand based on tariff schedules and facility usage
  - Goal: Demand and cost containment
- Adding energy storage system (ESS)
  - Battery-based ESS to enable rapid charging and to mitigate demand impacts of EV charging
  - Additional ways to utilize ESS for facility optimization including facility demand management, TOU/arbitrage, demand response, and ancillary services including frequency regulation
  - Goal: Cost containment and revenue generation
- EV Charging installation location further contributes to variability
  - Fleet EV charging generally has more predictability
  - Publicly accessible EV charging has more variability (e.g., retail vs. office with different time of day and usage patterns)

Grid Tied EV Charging + Storage

- Building Blocks:
  - ESS:
    - Residential sized ESS (10 kW|20 kWh)
    - Small commercial sized ESS (30 kW | 65 kWh)
    - Plus larger sized system options
  - EV Chargers
    - Level 2 chargers
    - Level 3 chargers

Energy Storage System Option Examples

Small Commercial System

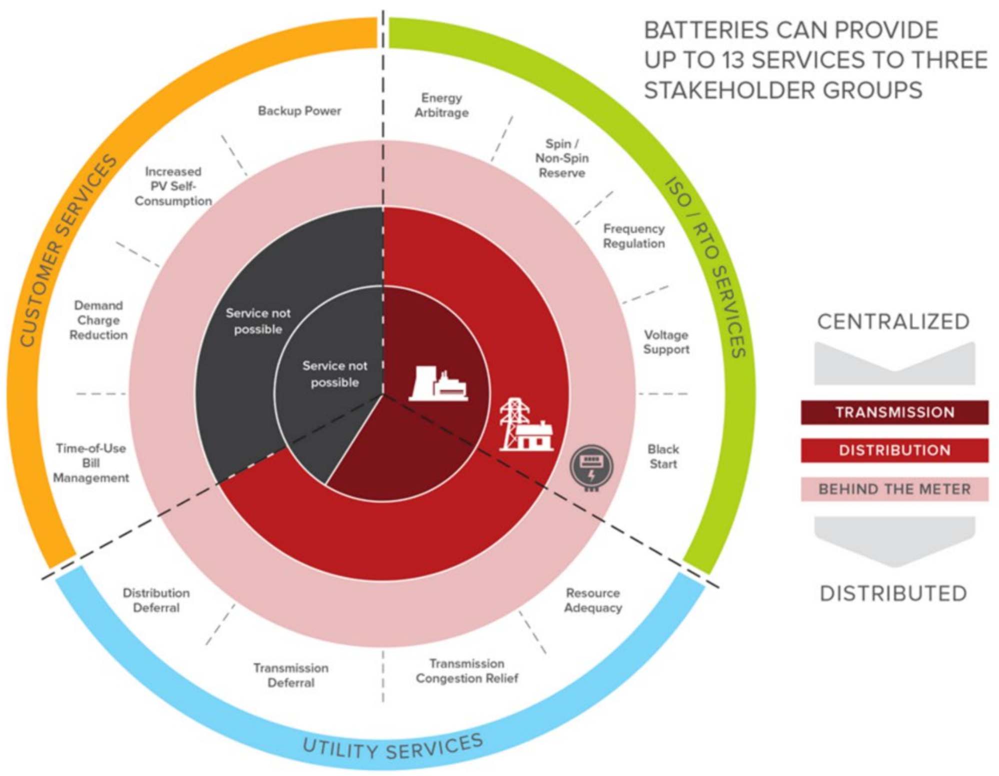
- Homegrid Power Bloc
- Multiple configurations from 9 to 45 kW and up to 153 kWh system in 8’x4’ footprint
- Supports single and 3 phase power applications
- Fully UL certified solution
- Equipment-only costing of around $65k-$70k for typical system, plus installation, etc.

Medium Commercial System

- Energport L180462
- Multiple configurations from 30 to 180 kW and up to 462 kWh system in 10’x8’ footprint
- Generally 3-phase, 480VAC power
- Fully UL certified solution
- Equipment-only costing of around $70k for small systems; up to $280k for largest configuration, plus installation, etc.
- Larger systems in 20’ and 40’ containerized footprint

Energy Storage Applications

- Cost savings depends on utility and tariff structure and includes:
  - Demand charge reduction
  - Time of use bill reduction
  - Energy arbitrage (charge during nighttime and low prices, discharge when prices are higher)
  - Etc.
- Revenue generation depends on utility and region (E.g., RTO such as PJM or MISO)
  - Demand response
  - Frequency regulation
  - Reserve markets (ancillary services)
- Resiliency and Power Quality
  - ESS provides greatest benefit when there are power quality issues and/or when there is regular grid outages
  - E.g., islanded solar+storage for critical load in long duration outages such as CA Public Safety Power Shutoff events



Other Considerations

- EV Charging
  - EV charging can increase the electricity usage
  - EV charging infrastructure can be installed at the same time as solar
  - Can consider installation of even small carport solar to highlight solar and EV charging at e.g., prime parking locations
- Energy Storage
  - Deployed for multiple benefits including: demand management, offset of EV charging demand impacts, revenue streams (in markets such as PJM), and resiliency for critical load
- Microgrid
  - Combination of solar, ESS, and backup generation can be combined into a comprehensive microgrid

EV Charging Deployment Costs

- Equipment cost is only part of the cost
- Installation costs include:
  - Engineering
  - Permitting
  - Electrical work
  - Civil work
  - Potential transformer and facility upgrades
- Operations costs include:
  - Software costs
  - Cellular network connectivity costs (unless using existing facility WiFi or ethernet, or non-networked)
  - Regular O&M services

	Level 2 Home	Level 2 Parking Garage	Level 2 Curb-side	DC Fast Charging	Description/Key Assumptions
Charge station hardware	$450–$1,000	$1,500–$2,500	$1,500–$3,000	$12,000–$35,000	
Electrician Materials	$50–$150	$210–$510	$150–$300	$300–$600	• $1.50–2.50/ft for conduit and wire, plus misc other materials • $50–80/hour (per dist?) • $500–1000 if new breaker is required • Assume 2x electrical cost for level 3
Electrician Labor	$100–$350	$1,240–$2,940	$800–$1,500	$1,600–$3,000	
Other Materials		$50–$100	$50–$150	$100–$400	• $25–100/ft for trenching/boring—depends on surface, soil, and underground complexity • Mounting, signage, protection, and restoration also included here, but don't usually contribute more than a few hundred dollars
Other Labor		$250–$750	$2,500–$7,500	$5,000–$15,000	
Transformer	NA	NA	NA	$10,000–$25,000	• 480V transformer installed by utility
Mobilization	$50–$200	$250–$500	$250–$500	$600–$1,200	• Home: 1–3 hours of electrician time for a home installation • Public: $250–500 of time for 1–2 electricians and other labor. We found that the work could usually be completed in a single visit from each contractor.
Permitting	$0–$100	$50–$200	$50–$200	$50–$200	• Varies city to city, often a flat fee for one or several stations

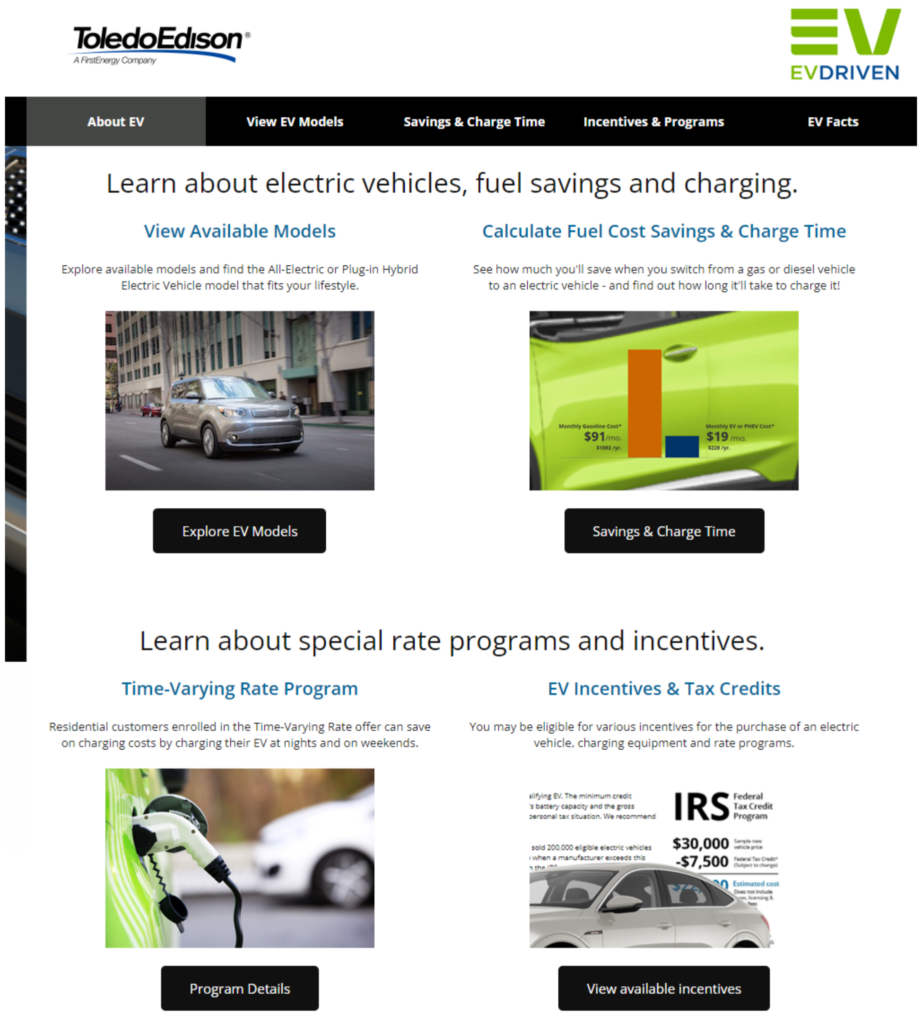
https://www.ohmhomenow.com/electric-vehicles/ev-charging-station-cost/

Example EV Charging Deployment

- If facility is not public facing, revenue collection for EV charging usage not likely a strong consideration
  - If public facing, then revenue collection for EV charging is typically required, slightly higher cost for chargers
- Level 2 chargers for employees and customers
  - Installed cost of $10k-$12k per pedestal (single pedestal services 2 cars)
  - Each pedestal adds as much as 10-15 kW demand impact to facility usage when charging vehicles
- Level 3 chargers for vendors and delivery vehicles
  - Installed cost of ~$60k-$70k per pedestal (single pedestal services 1 vehicle)
  - Each pedestal adds as much as 50 kW demand impact to facility usage when charging vehicles
- Offset demand impact with Energy Storage System

Rebates and Incentives for EV Charging

- State and Local:
  - Some states and local municipalities have grant or other incentives for EV charging deployments
- Utility:
  - Many utilities have rebate programs for EV charging deployments
  - Options for special rate plans (tariffs) for EV charging, particularly for home EV charging (e.g., lower nighttime rate to incentive overnight charging)
- Federal:
  - Federal tax credits (investment tax credit) of 30% of EV charger costs with maximum $30,000 credit for commercial installations
  - Higher tax credits possible when pairing EV charging with e.g., solar and energy storage deployments
- Some incentives require e.g., public access to EV charging



“Standard Offers” For Solar + EV Charging + ESS Options

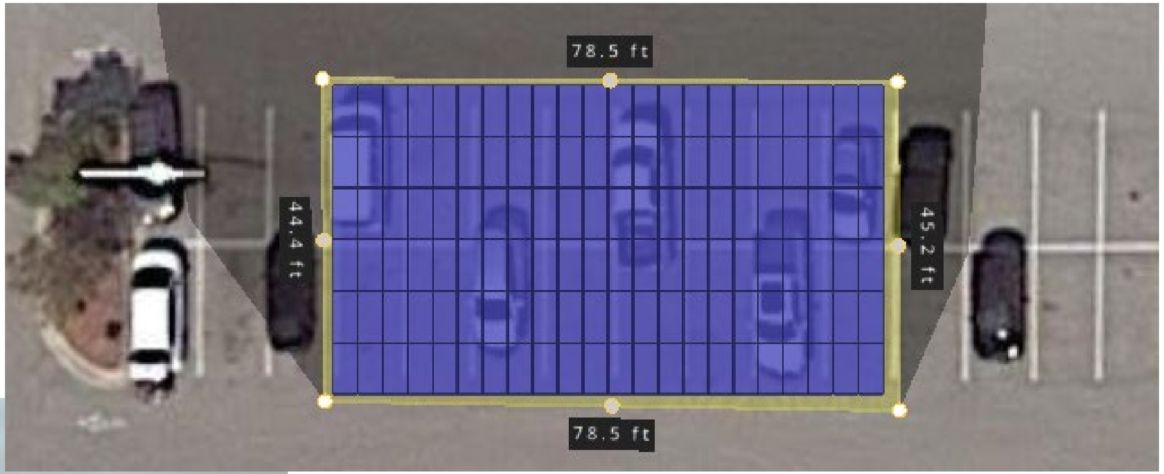
System Options

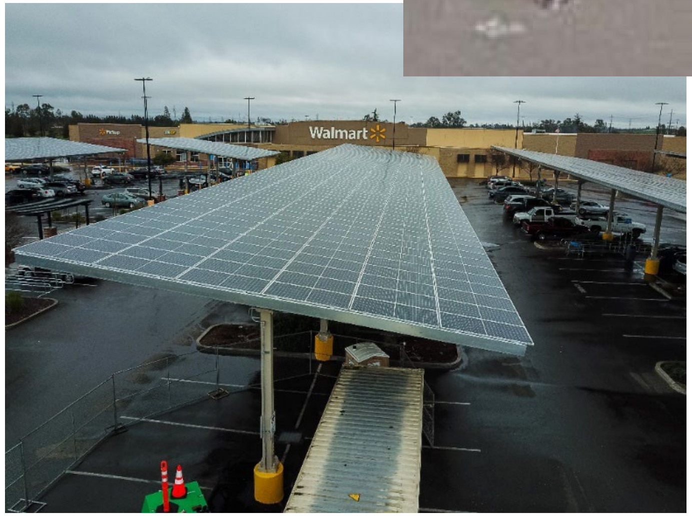
Tier	EV Charging Components	Solar Components	Estimated Cost
Bronze Roof	2 Level 2 charger capacity	20 kWdc rooftop solar	$94,000
Bronze Carport	2 Level 2 charger capacity	20 kWdc carport solar	$100,000
Silver Roof	4 Level 2 charger capacity	60 kWdc rooftop solar	$259,000
Silver Carport	4 Level 2 charger capacity	60 kWdc carport solar	$309,000
Gold Roof	6 Level 2 charger capacity	100 kWdc rooftop solar	$415,000
Gold Carport	6 Level 2 charger capacity	100 kWdc carport solar	$498,000

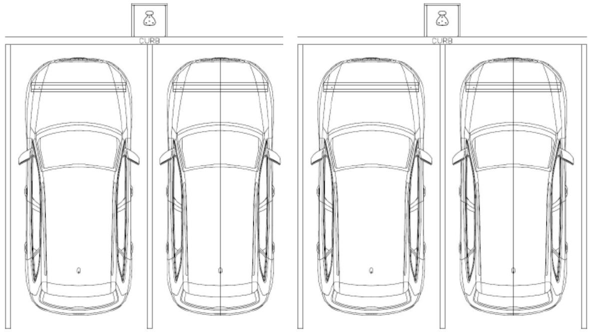
- Includes all equipment and estimated installation
- EV charging includes non-networked Level 2 EV chargers with credit card capability
  - Upgrade to ChargePoint with app is Basic EV Charging-Only System: Single dual-vehicle level 2 charger is $2k/dispenser
  - Option to add Level 3 chargers
- Option to add Energy Storage with sizing based on site usage and value proposition

Example: Silver Carport

- Solar:
  - 60 kWdc carport canopy solar
  - Covers ~16 parking spots
- EV charging:
  - Dual pedestal Level 2 charger with 2 dispensers each (capable of charging 4 vehicles at the same time)
  - Mounted underneath canopy







About Enerlogics

Enerlogics Overview

- **Enerlogics Networks, Inc.** ("Enerlogics") brings industry-leading expertise in energy solutions for commercial, industrial, and institutional clients.
- With industry-leading expertise in solar, energy storage, EV charging, demand response, and energy efficiency program execution, Enerlogics develops cost-effective solutions for clients.
- Founded in 2009, Enerlogics has developed projects and programs across the US including 6 regional campus solar program for Kent State University (OH), C&I energy storage program for Marin Clean Energy (CA), and a solar+storage program for the City of Ann Arbor (MI).
- Enerlogics is based in Youngstown, OH.

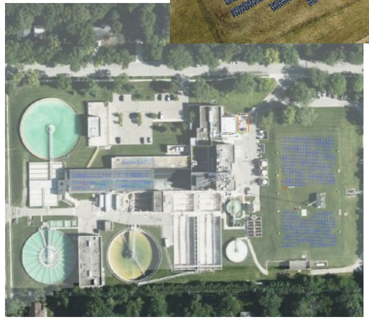
Enerlogics Representative Development Experience

Brooklyn Solar Project
4 MWdc solar project constructed on a former landfill in Brooklyn, Ohio.

Cuyahoga County Rooftop Solar Program
1.4 MWdc multi-site deployment of solar systems on various sites within Cuyahoga County.

City of Lakewood Ohio
650 kWdc multi-site deployment of rooftop solar systems on various sites within the City of Lakewood Ohio.

City of Cleveland Heights Ohio
828 kWdc multi-site deployment of rooftop solar systems on various sites within the City of Cleveland Heights Ohio.



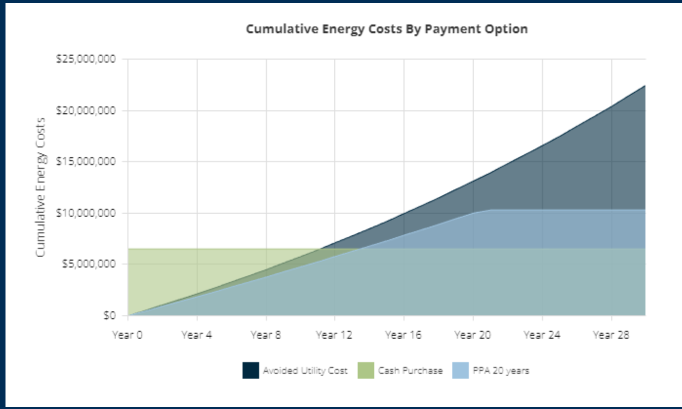
Penta Career Center
1.3 MWdc ground mount solar project constructed at Penta Career Center in Perrysburg, Ohio.

Kent State University
Multi- site deployment for the Kent State University regional campus throughout Eastern Ohio; . 6-campus, 3.4 MWdc solar project that includes both ground mount and rooftop solar

City of Ann Arbor
Multi-site deployment of solar systems on various sites within the City of Ann Arbor. Up to 4.2 MWdc of solar across all locations including ground mount, rooftop, and floating solar.

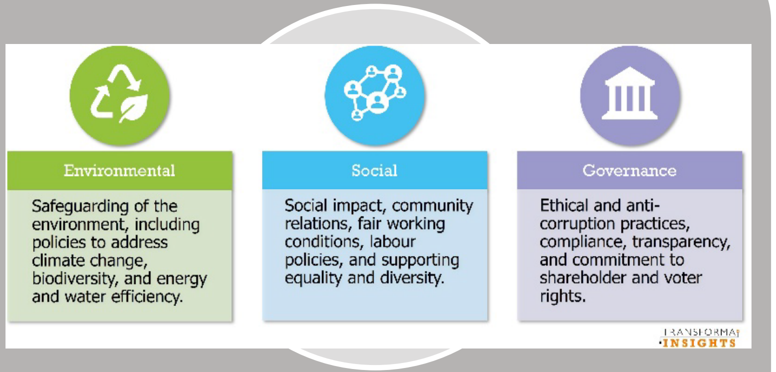
Marin Clean Energy
Delivery of the C&I energy storage program to locations throughout MCE's territory.

Clean Energy Drivers



Electricity Cost Savings to Combat Rising Electricity Costs

- Utilize lower-cost solar with predictable power costs for next 25+ years



Achieve sustainability goals

- Use locally-generated solar (and energy storage) to reduce costs and carbon footprint

IRA Investment Tax Credits	Value
Base	30%
Domestic Content	10%
Energy Community	10%
Low Income Community	10% / 20%

Base with prevailing wage/apprenticeship for projects > 1 Mwac

Low-income area at 10%, 20% if providing power to low-income households

Leverage tax benefits

- Capture tax benefits of the Inflation Reduction Act (IRA) to reduce delivery costs under both cash purchase and third party financed options

Benefits of Solar and Energy Storage

Typical Project Development Process

Multistep process with full customer engagement throughout

How we can help

- Enerlogics and Centurion can be your development partner
- Evaluation of your current and future plans
- Coordination of multiple system options including solar, energy storage, and EV charging
  - Sub options on equipment and deployment types
- Cost and benefit analysis
- Full turnkey deployment including installation and operations
- Optional project financing under lease, PPA, PACE, etc.

Want to know more?

- Corporate:
  - Visit us on the web at www.enerlogics.com
  - Call us at 216.362.3000
  - Email us at info@enerlogics.com

- Or contact:

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  sameduri@enerlogics.com