Modernizing the Grid
EV Charging and Energy Storage

FreeWire Technologies
June 2023

Chip Silverman, FreeWire Technologies
csilverman@freewiretech.com

Today's Agenda

- Boost Product Series
  - High-power charging with minimal grid impact
  - Siting flexibility
  - Rapid deployment

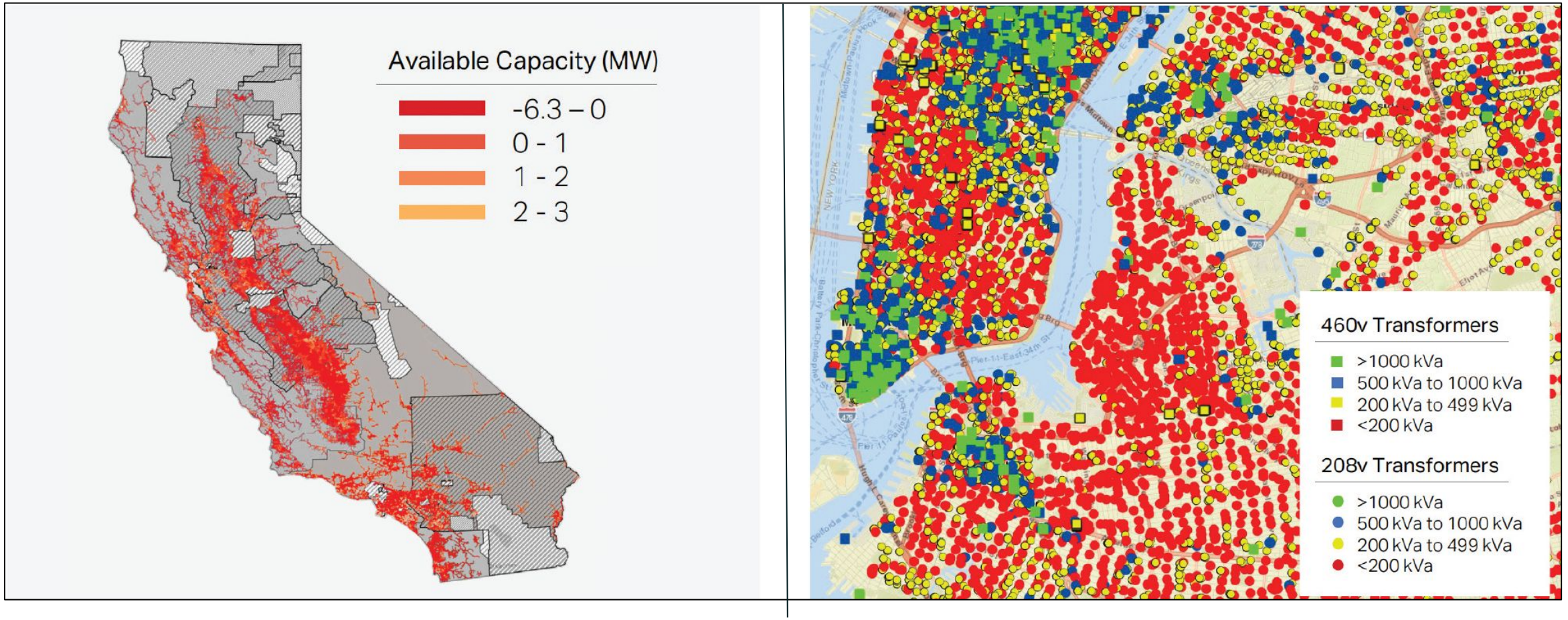
- Grid Benefits
  - Deferred upgrades on utility side of the meter
  - Maximize the efficiency of the *existing* electric grid
  - Enables load flexibility

- Customer Benefits
  - Quicker and more cost effective installation and energization
  - Operating cost savings

- Recommendations to Accelerate Beneficial Electrification

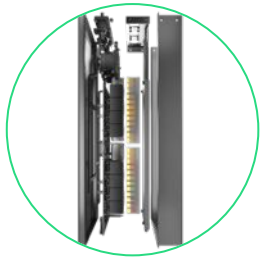
Boost Product Development

The Distribution Grid Lacks Capacity at the Grid Edge

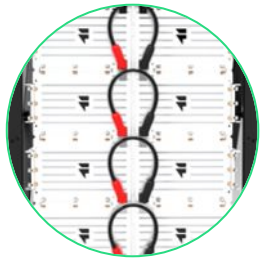


Hosting Capacity Maps of California and New York City

High-Power EV Charging With Minimal Grid Impact



NEXT-GEN POWER CONVERTER
Proprietary power conversion technology with silicon carbide architecture & 99% efficiency



ADAPTIVE BATTERY PACK
Proprietary 160 kWh battery pack with flexible architecture that switches between 400V & 800V

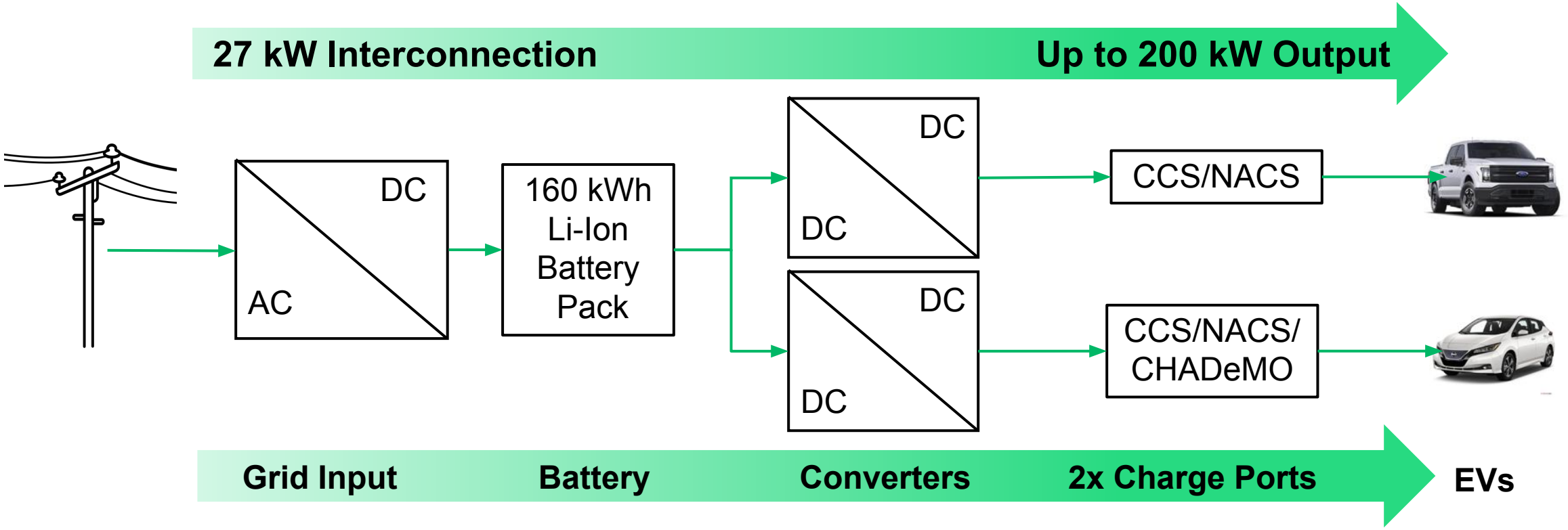
Envision AESC

ADVANCED CONTROL SYSTEM
Optimized to enable distributed energy services

Product Roadmap

Boost 120	27 kW Input / 120 kW Output
Boost 150	**27 kW Input / 150 kW Output**
Boost 200	**27 kW Input/ 200 kW Output**
Boost Pro	Grid Down (Resilient Charging)
Boost Power	Fully Bi-Directional (Charger-to-Everything)

High-power Output From Battery, Buffering the Grid



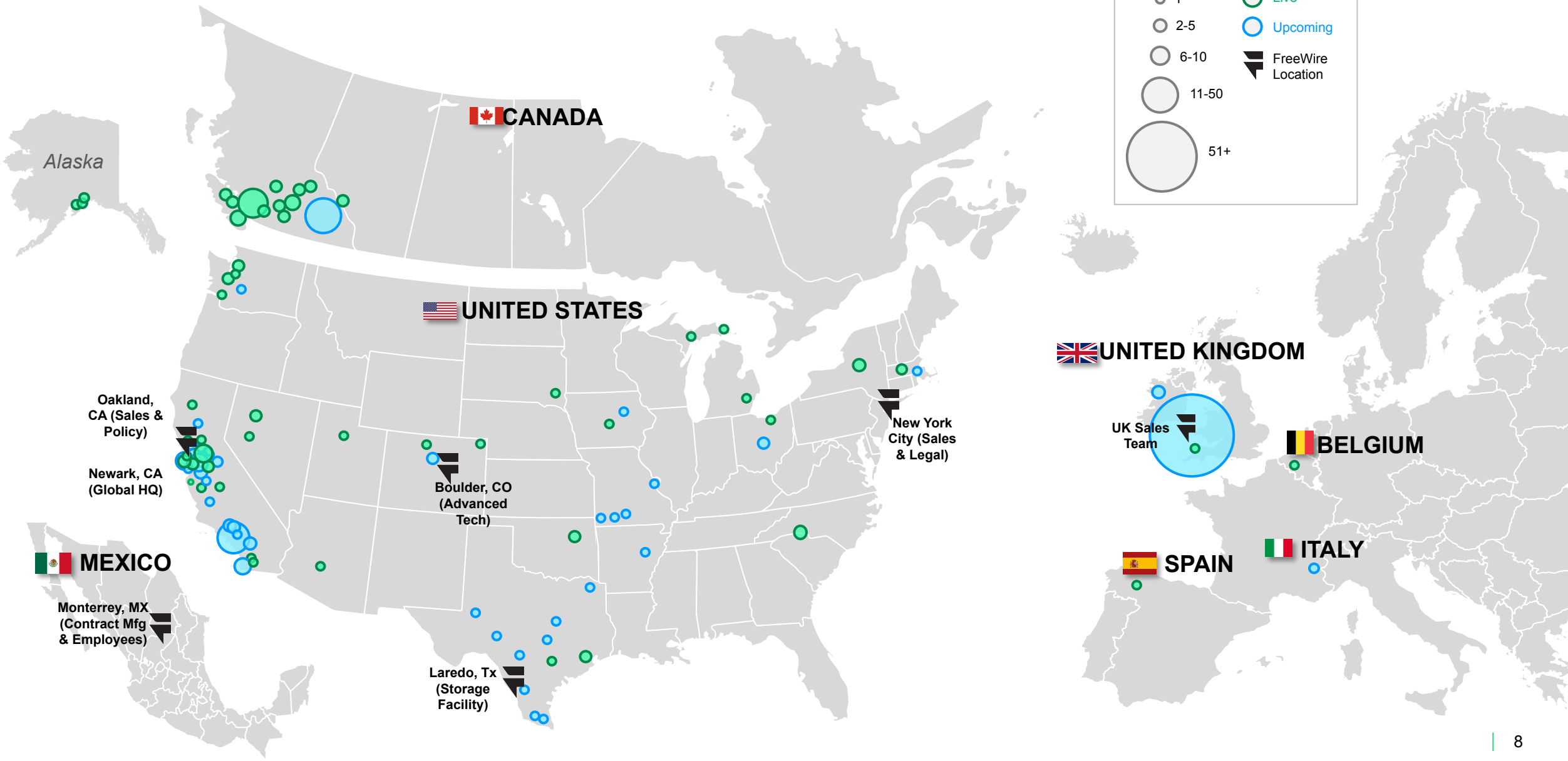
Can charge EVs up to 200 kW with 87% less grid power

Enabling Rapid Deployment of DCFC Using Existing Grid Infrastructure

Charging Type	Voltage	Amperage	Output Power Range
Level 1	120 volts	15 amps	1.4 kW
Level 2	240 volts 208 volts	32 amps	3 - 19 kW
FreeWire Battery-Integrated EVSE	240 volts 208 volts 480 volts	150 amps 100 amps	200 kW
Conventional Level 3 / DC Fast Charging w/o ESS	480 volts	200 - 300 amps	100 - 350 kW

EV charging using widely available, existing 208 or 240-volt service

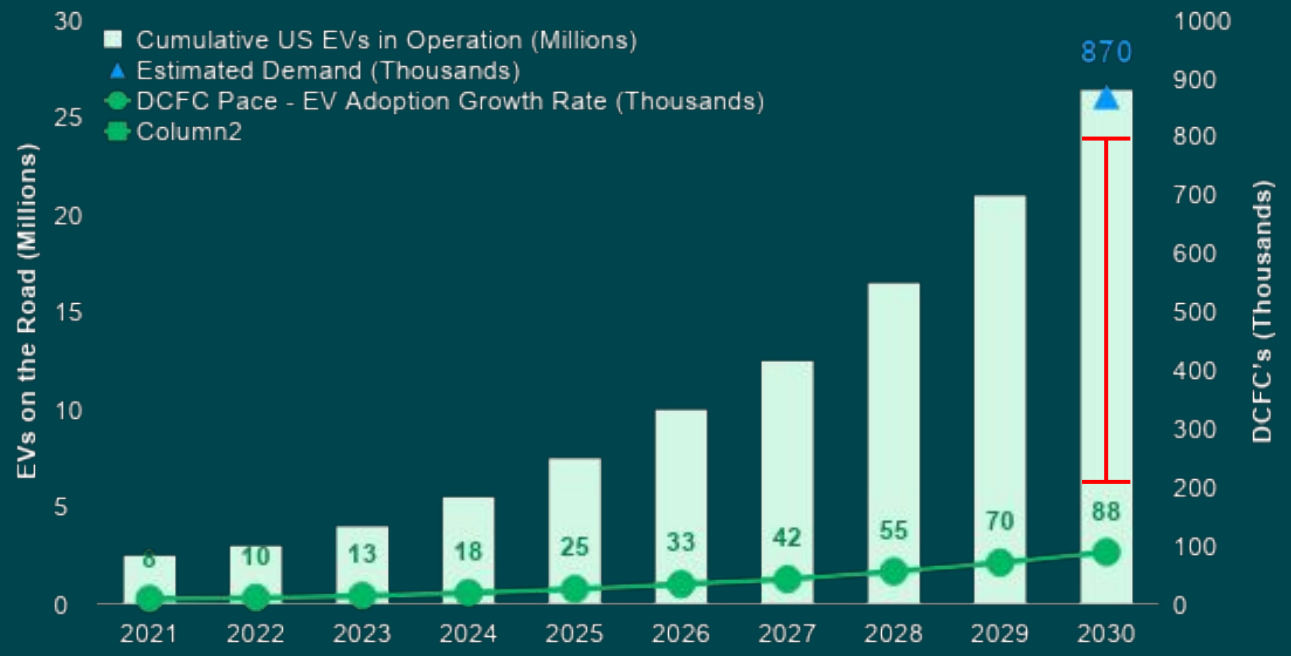
Global Presence



Grid Benefits

Pace of Charging Install Lags Demand

Charging Infrastructure Demand 10X Current Pace of Deployment



Utilities & Grid Infrastructure are Primary Reason for this Gap

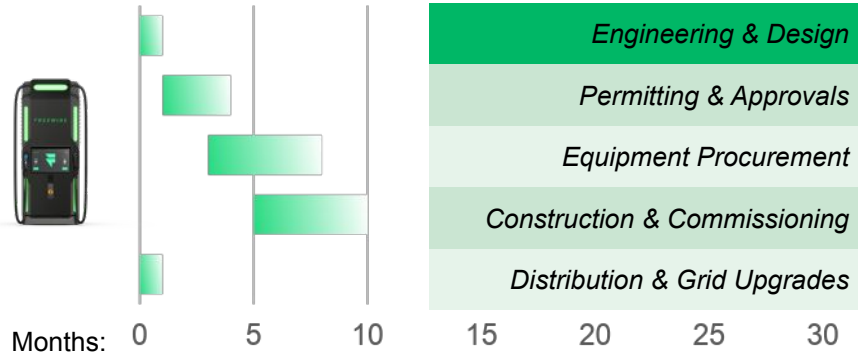
- Transformers procurement times +429% for public power in ‘20 – ‘22
- Some utilities quoting lead times of 3+ years
- 1 in 5 public power utility projects were deferred or canceled due to transformer procurement challenges

Note: DCFC targets excluding Tesla charging stations that are closed network
“DCFC Pace – EV Adoption Growth Rate” follows EV Adoption YoY growth
Source: McKinsey “Building the electric-vehicle charging infrastructure America needs”; APPA Transformer Production Survey, Oct ‘22

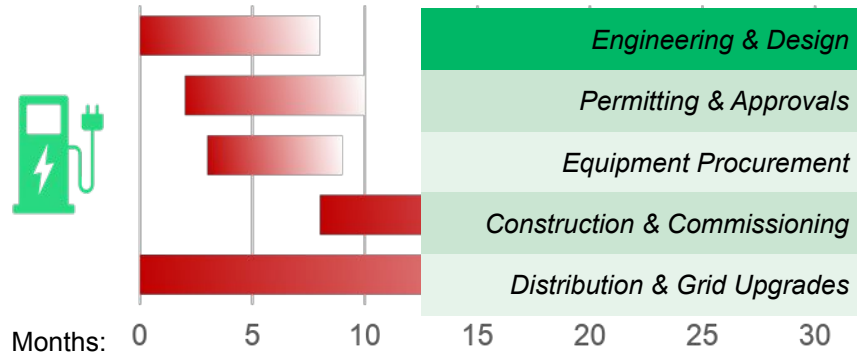
The Solution

Energy Storage Accelerates Deployment

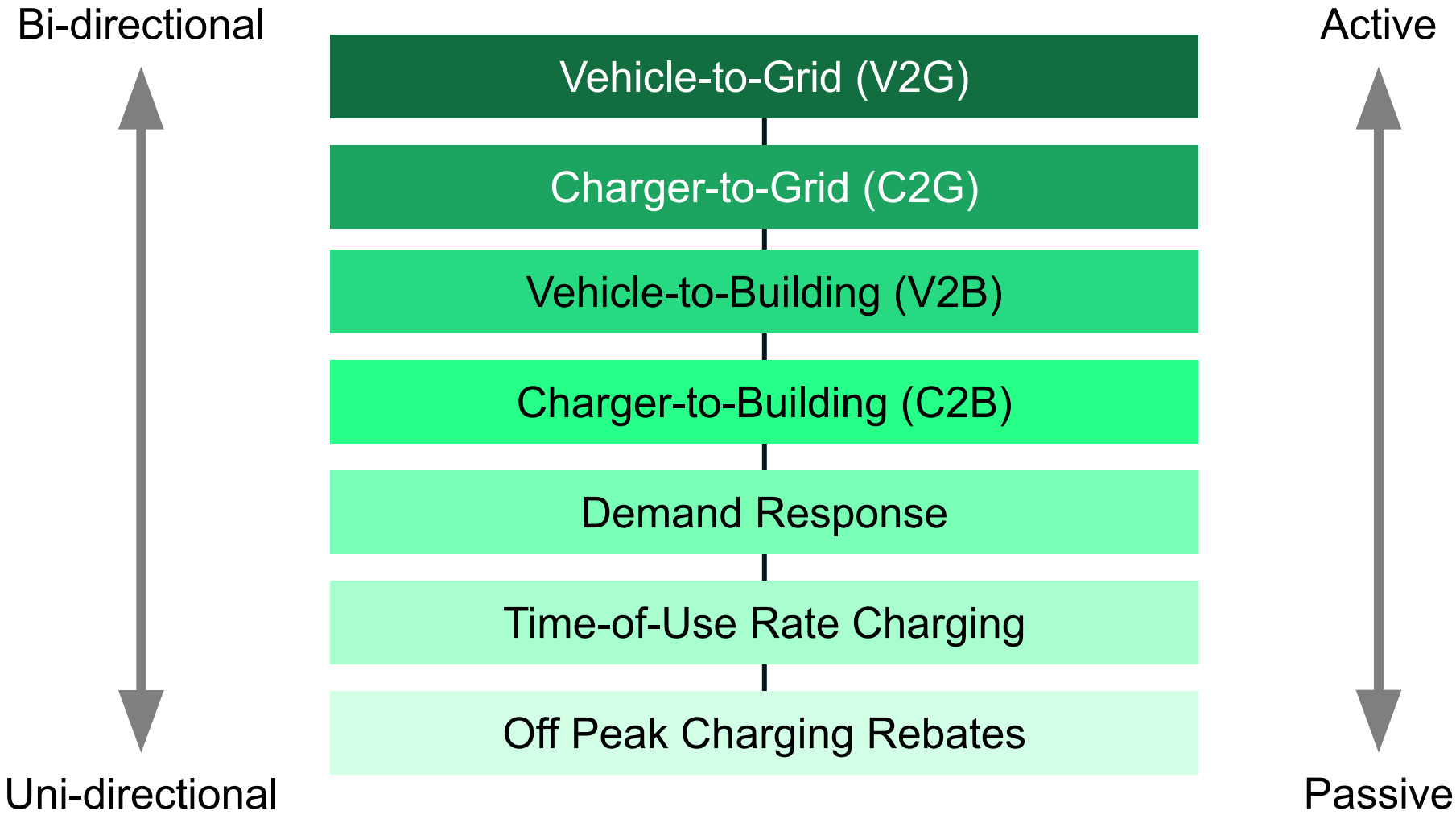
4 - 16 Weeks FreeWire Boost Charger Installation



12 - 30+ Months Traditional Fast Charger Installation



VGI Technologies Enables Load Flexibility



Customer Benefits

Boost Can Reduce Estimated Customer Side of the Meter Install Costs by 31% to 75% Depending on the Site

		Behind the Meter Install Cost Ranges		
Assumption	Charging Ports (#)	Low	Average	High
1x Boost Chargers per Site	2	$21,015	$49,265	$77,515
2x 150 kW Conventional DCFC	2	$84,265	$98,015	$111,765

			Scenario 1			
			Low		High	
Item	Unit of Measure	Unit Cost	Quantity	Subtotal	Quantity	Subtotal
175-A Circuit Breaker	EA	$ 695.00	1	$ 695.00	1	$ 695.00
#2/0AWG Copper Conductor	LF	$ 4.40	700	$ 3,080.00	0	$ -
500MCM Copper Condctor	LF	$ 13.00	0	$ -	2240	$ 29,120.00
2-1/2" PVC Schedule 80 Conduit	LF	$ 6.50	100	$ 650.00	0	$ -
4" PVC Schedule 80 Conduit	LF	$ 12.00	0	$ -	280	$ 3,360.00
2-1/2" EMT	LF	$ 19.25	75	$ 1,443.75	0	$ -
4" EMT	LF	$ 34.00	0	$ -	280	$ 9,520.00
Equipment Ground Conductor	LF	$ 1.75	175	$ 306.25	560	$ 980.00
Ground Rod	EA	$ 150.00	1	$ 150.00	1	$ 150.00
Bollards	EA	$ 500.00	0	$ -	2	$ 1,000.00
Concrete Pad	CY	$ 850.00	0.75	$ 637.50	0.75	$ 637.50
Surge Protective Device	EA	$ 350.00	1	$ 350.00	1	$ 350.00
Trenching	LF	$ 10.00	100	$ 1,000.00	0	$ -
Directional Boring	LF	$ 15.00	0	$ -	280	$ 4,200.00
Junction Box	EA	$ 1,500.00	0	$ -	1	$ 1,500.00
112.5-kVA Step-Down Transformer	EA	$ 7,500.00	0	$ -	0	$ -
175-A Enclosed Circuit Breaker	EA	$ 2,500.00	0	$ -	0	$ -
1000-A 208V Service Entrance Board	LS	$ 24,000.00	0	$ -	0	$ -
2000-A 208V Service Entrance Board	LS	$ 46,000.00	0	$ -	0	$ -
Permit Costs	LS	$ 1,000.00	1	$ 1,000.00	1	$ 3,000.00
Boost Charger Install	LS	$ 7,500.00	1	$ 7,500.00	1	$ 7,500.00
	Sub Total			$ 16,812.50		$ 62,012.50
	25% Contingency			$ 4,203.13		$ 15,503.13
	Total			$ 21,015.63		$ 77,515.63

			2 Traditional 150kW Install			
			Low		High	
Item	Unit of Measure	Unit Cost	Quantity	Subtotal	Quantity	Subtotal
300-A Circuit Breaker	EA	$ 3,500.00	2	$ 7,000.00	2	$ 7,000.00
300MCM Copper Conductor	LF	$ 9.50	200	$ 1,900.00	400	$ 3,800.00
250 MCM 1000V Copper Conductor	LF	$ 13.00	200	$ 2,600.00	400	$ 5,200.00
4" PVC Schedule 80 Conduit	LF	$ 12.00	400	$ 4,800.00	800	$ 9,600.00
Equipment Ground Conductor	LF	$ 1.75	400	$ 700.00	800	$ 1,400.00
Ground Rod	EA	$ 150.00	2	$ 300.00	2	$ 300.00
Bollards	EA	$ 500.00	0	$ -	2	$ 1,000.00
Concrete Pad	CY	$ 850.00	2.25	$ 1,912.50	2.25	$ 1,912.50
Surge Protective Device	EA	$ 350.00	2	$ 700.00	2	$ 700.00
Trenching	LF	$ 10.00	400	$ 4,000.00	400	$ 4,000.00
Directional Boring	LF	$ 15.00	0	$ -	400	$ 6,000.00
Junction Box	EA	$ 1,500.00	0	$ -	2	$ 3,000.00
400-A 480V Service Entrance Board	LS	$18,500.00	1	$ 18,500.00	1	$ 18,500.00
Permit Costs	LS	$ 1,000.00	1	$ 1,000.00	1	$ 3,000.00
150kW Charger Install	LS	$12,000.00	2	$ 24,000.00	2	$ 24,000.00
	Sub Total			$ 67,412.50		$ 89,412.50
	25% Contingency			$ 16,853.13		$ 22,353.13
	Total			$ 84,265.63		$111,765.63

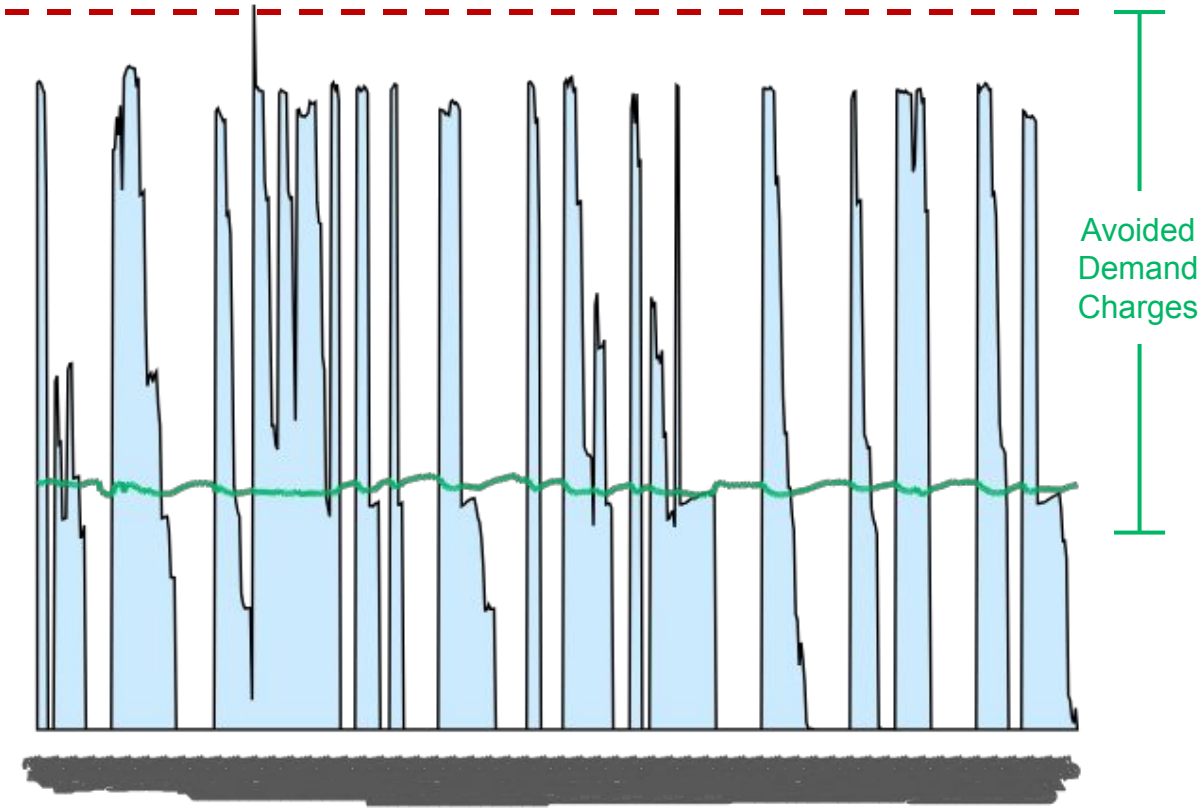
Source: FreeWire and Kimley Horn Analysis

Lower Energy Costs by Eliminating Demand Charges

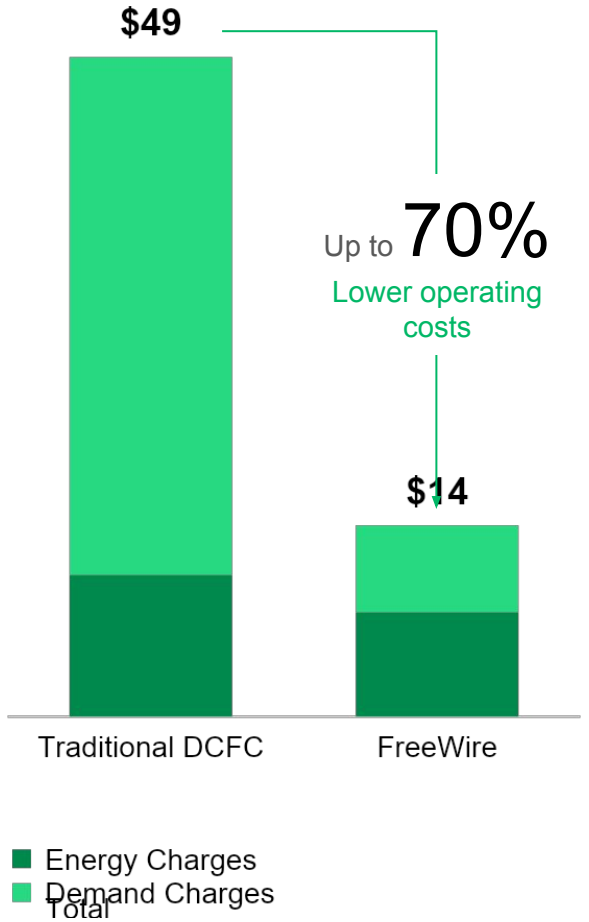
Daily Charging Sessions and Grid Impact

200kW
Traditional DCFC
Grid Impact

22kW
Boost Charger
Grid Impact



Energy Cost Savings



(1) PG&E demand charge schedule and PG&E tiered energy usage charge structure. Assumes equivalent energy consumption.

Vehicle Grid Integration

What Energy Services Can VGI Technologies Provide?

Energy Service Provided	Customer	Value	C2X (Battery-integrated EVSE)	V2X (Vehicle Battery)
Resilient Charging	EV Driver	$	✅	⛔
Backup Power	Site	$ - $$$	✅	⚠️
Demand Charge Management	Site	$ - $$$	✅	⚠️
Time of Use Load Shifting	Site	$	✅	⚠️
Demand Response	Utility	$ - $$$	✅	⚠️
Non-wires Alternative / T&D Deferral	Utility	$$$	✅	⛔
Capacity / Resource Adequacy	Utility	$ - $$$	✅	⚠️
Ancillary Services	ISO / RTO	$ - $$$	✅	⚠️

Recommendations

Key Recommendations to Accelerate Beneficial Electrification

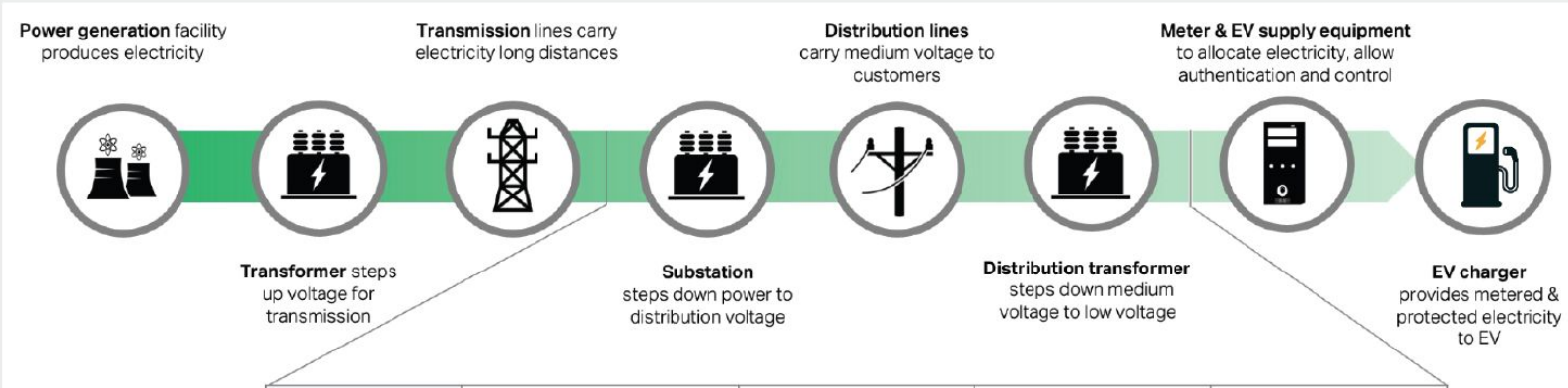
- Encourage customers to manage their grid impact
  - Prescriptive incentive based on shared savings of avoided/deferred upgrades
  - Expansion of managed charging programs
  - Clear process/flow chart showing customer journey for interconnection and how it could be expedited with load management technologies

- Proactive grid planning
  - Primary and secondary distribution grid considerations
  - Improved hosting capacity maps

- Bottoms up beneficial electrification study
  - Include non-highway sites

Appendix

Costly and Time-Consuming Upgrades to Distribution Grid Required to Support Widespread Public Fast Charging

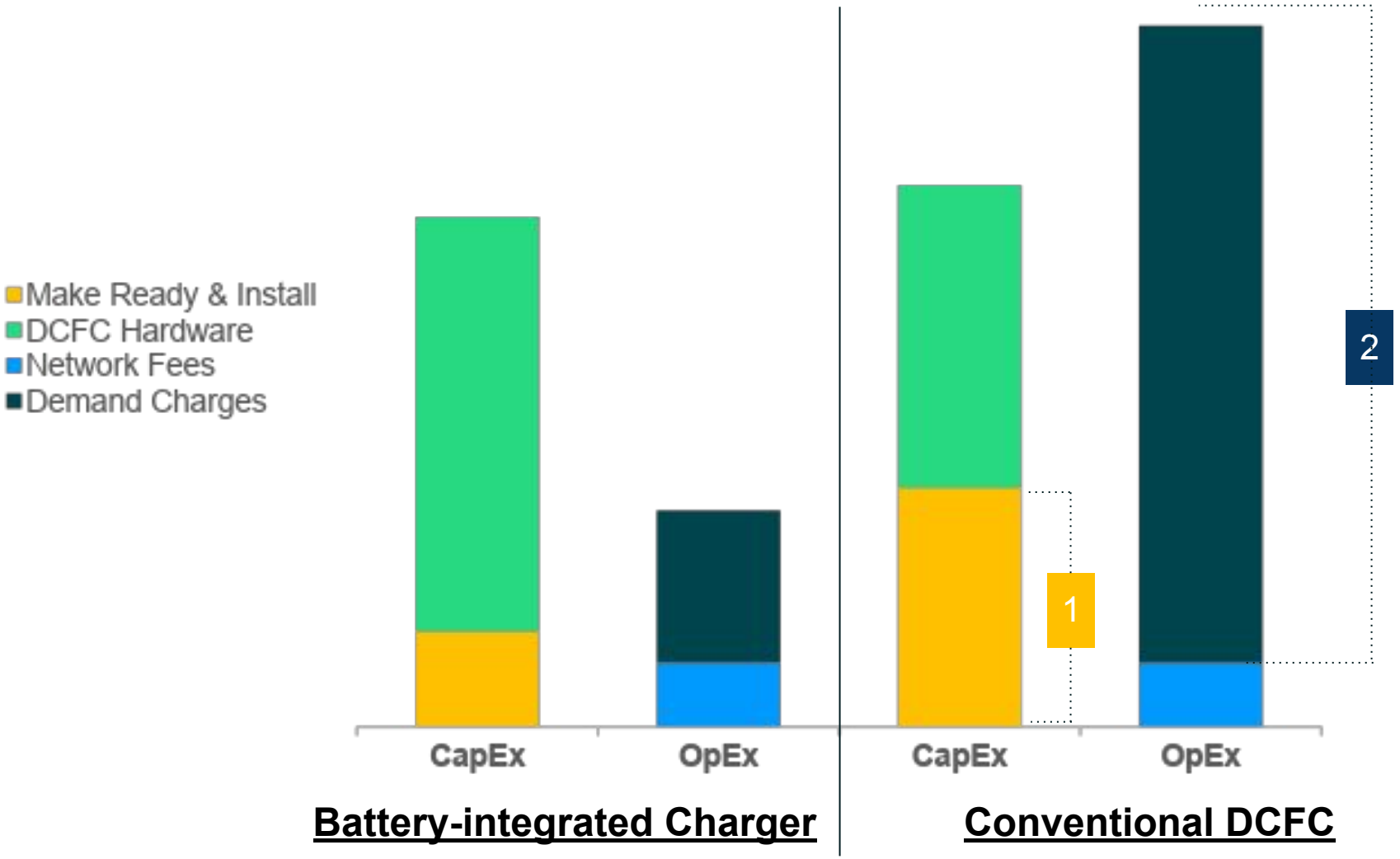


COMPONENT	Distribution Substation	Distribution Substation	Distribution Feeder	Distribution Feeder
UPGRADE	Build New	Upgrades	Add Feeder Breaker	Extend or Upgrade
WHAT TRIGGERS UPGRADES	>3-10 MW Added	>3-10 MW Added	>5 MW Added	>5 MW Added
TYPICAL COST	$4-35 Million	$3-5 Million	$400 Thousand	$2-12 Million

COMPONENT	Build New Substation	Upgrade Existing Substation	Add Feeder Breaker	Distribution Feeder Extension / Upgrades	Distribution Transformer
TYPICAL TIMEFRAME (MONTHS)	24-48	12-18	6-12	3-12	18-24

Utility side of the meter upgrades can be expensive and time-consuming but customer's have little visibility into them or incentive to avoid them.

Illustrative TCO Comparison



Many state and utility programs focus on subsidizing:

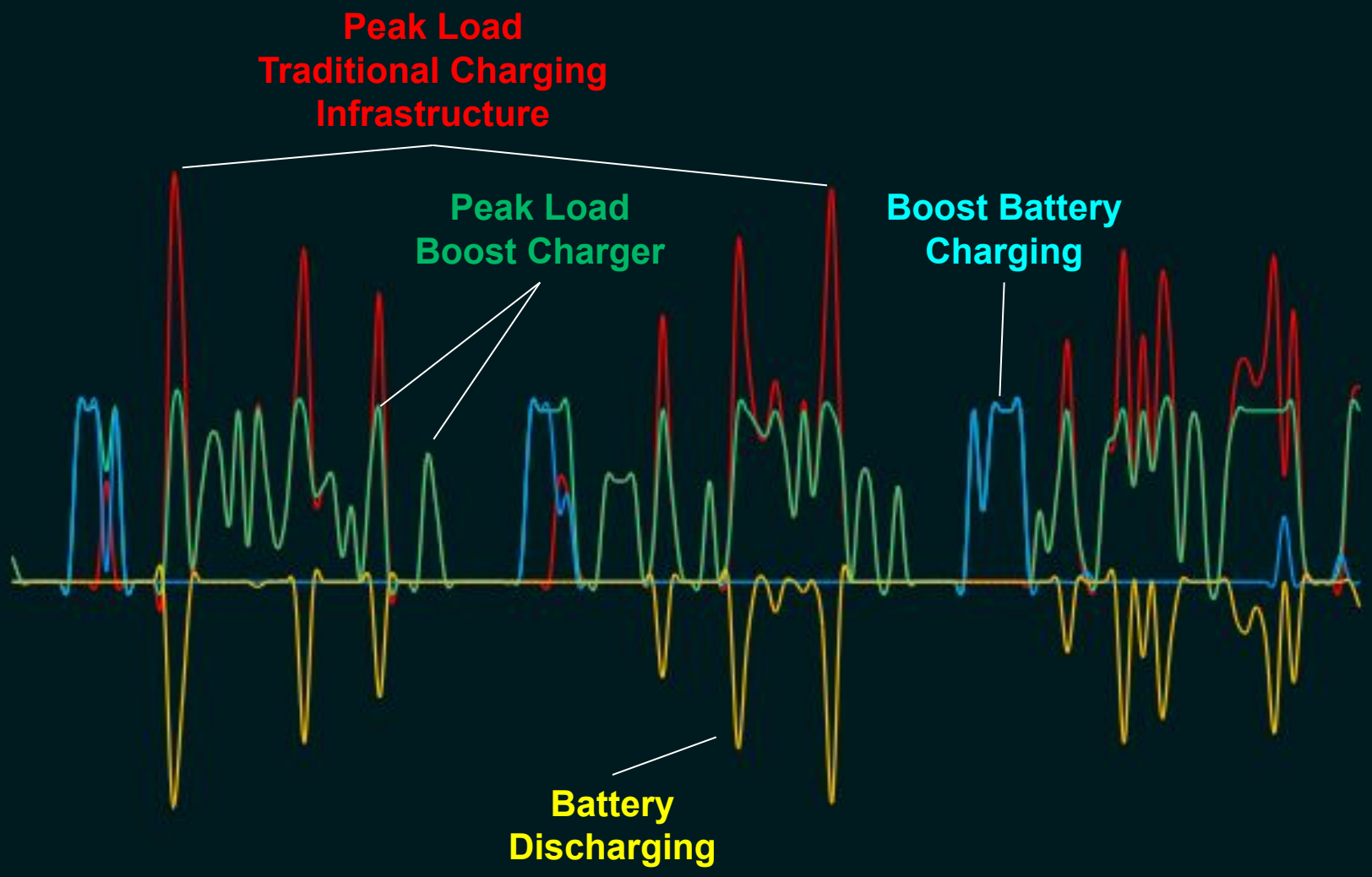
1 Make-ready

2 Demand Charges

Battery-integrated EVSE are designed to minimize these costs in the first place

Customers lack price signals to choose load management solutions because make-ready payments and demand charge relief subsidize the total cost of ownership of Conventional DCFC

Integrated Battery Enables Demand Charge Mitigation and Energy Arbitrage



(1) PG&E demand charge schedule and PG&E tiered energy usage charge structure. Assumes equivalent energy consumption.

The Next Wave of EV Charging Infrastructure

Turnkey

Complex Infrastructure Project

Fully-Integrated

BOOST CHARGER

VS

Charging Infrastructure

DISPENSER + POWER CABINET

Grid Infrastructure

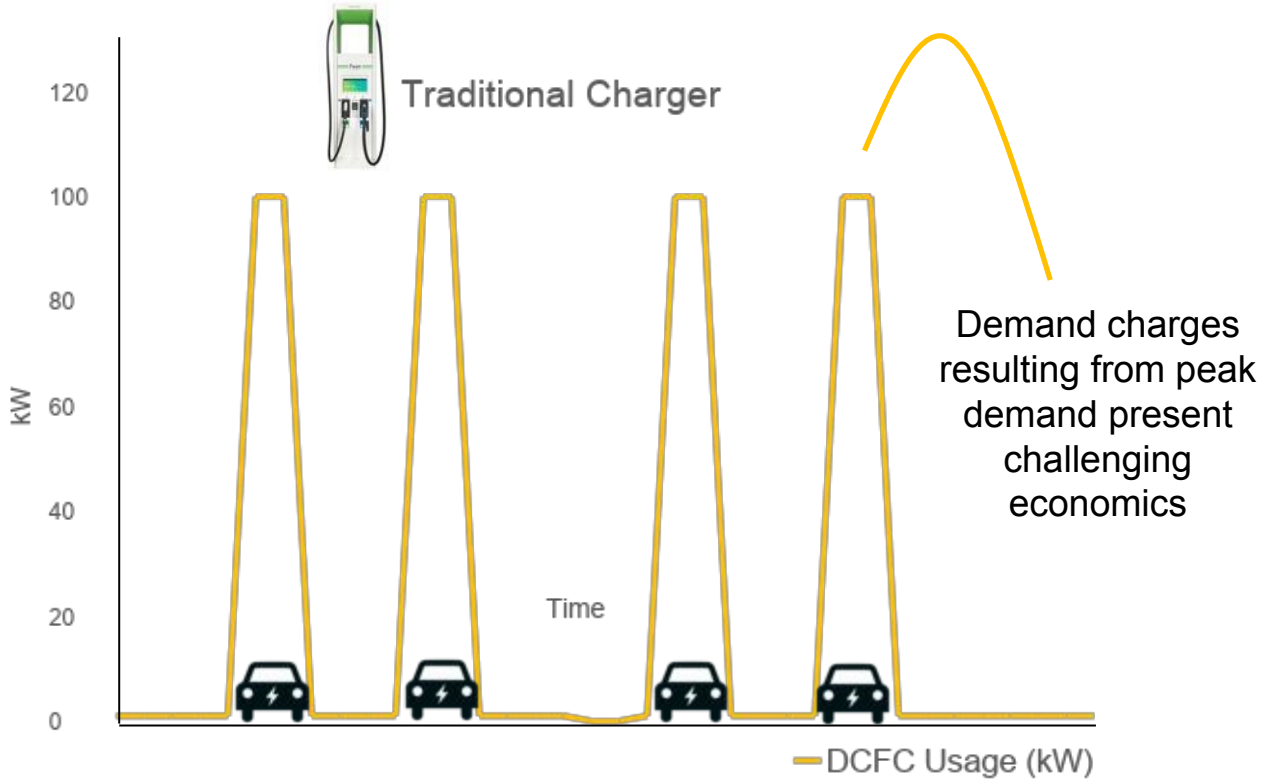
SWITCHGEAR + TRANSFORMER

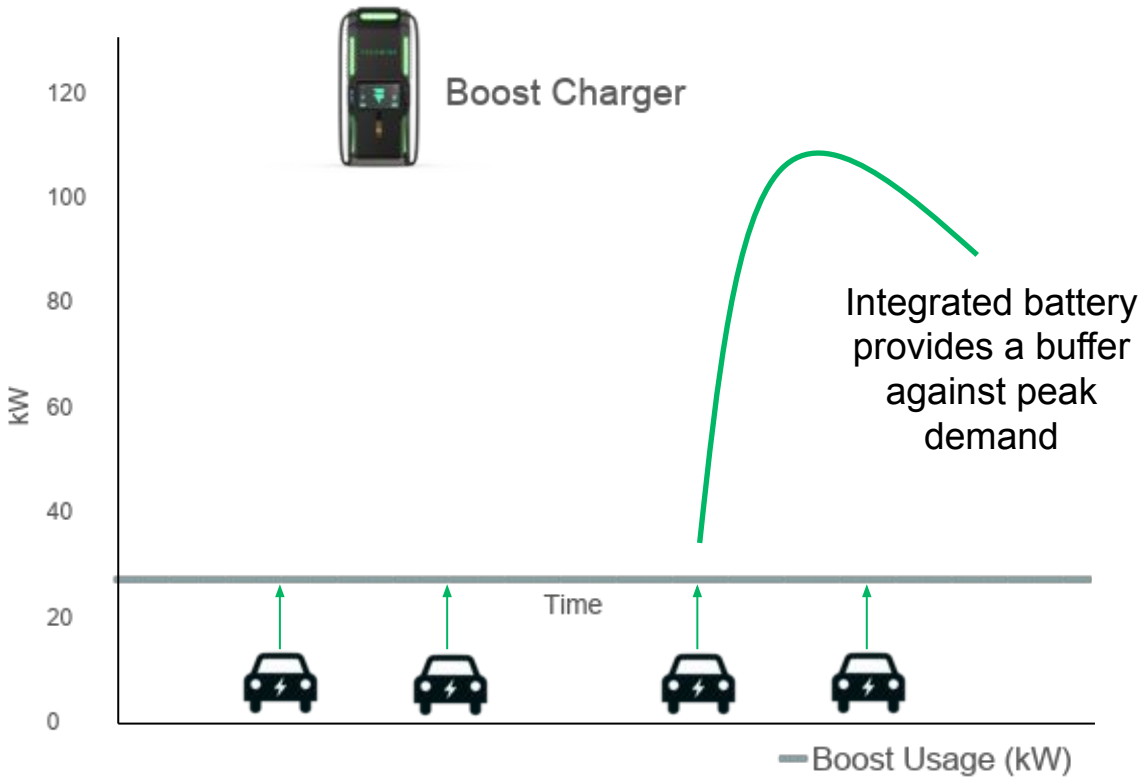
Energy Storage

BATTERY + INVERTER

FreeWire's approach delivers same output with a smaller footprint due to minimized on-site make ready infrastructure

Technology Solution to Mitigating Demand Charges





Integrated batteries reduce demand charges and can respond to TOU or other energy pricing mechanisms

FreeWire Technologies

Leading manufacturer of battery-integrated Direct Current Fast Chargers (“DCFC”)

Who	FreeWire was founded in 2014 in San Leandro, California
What	Flexible, turnkey EV charging & power solutions w/ energy storage
Customers	Retail, fleets, public, utility, automotive, workplace, local gov

Investors include:

BlackRock, bp, River Stone, Energy Innovation Capital, ABB, Blue Bear Capital, GLy Capital Management, Octave Ventures

Customers include:

Phillips 66, Road Ranger, TA, American Electric Power, American Red Cross, Duke Energy, massDOT Massachusetts Department of Transportation, Tri-State, Rotten Robbie, meijer, Google, Netflix, LinkedIn, LA DWP Los Angeles Department of Water & Power, New York Power Authority, Mack

Boost Charger™ in Lodi, CA

FREEWIRE