Electric Vehicles as a Modern Grid Distributed Energy Resource (DER)

MSSIA Powering Tomorrow: Advancing Grid Modernization in NJ, PA, and DE

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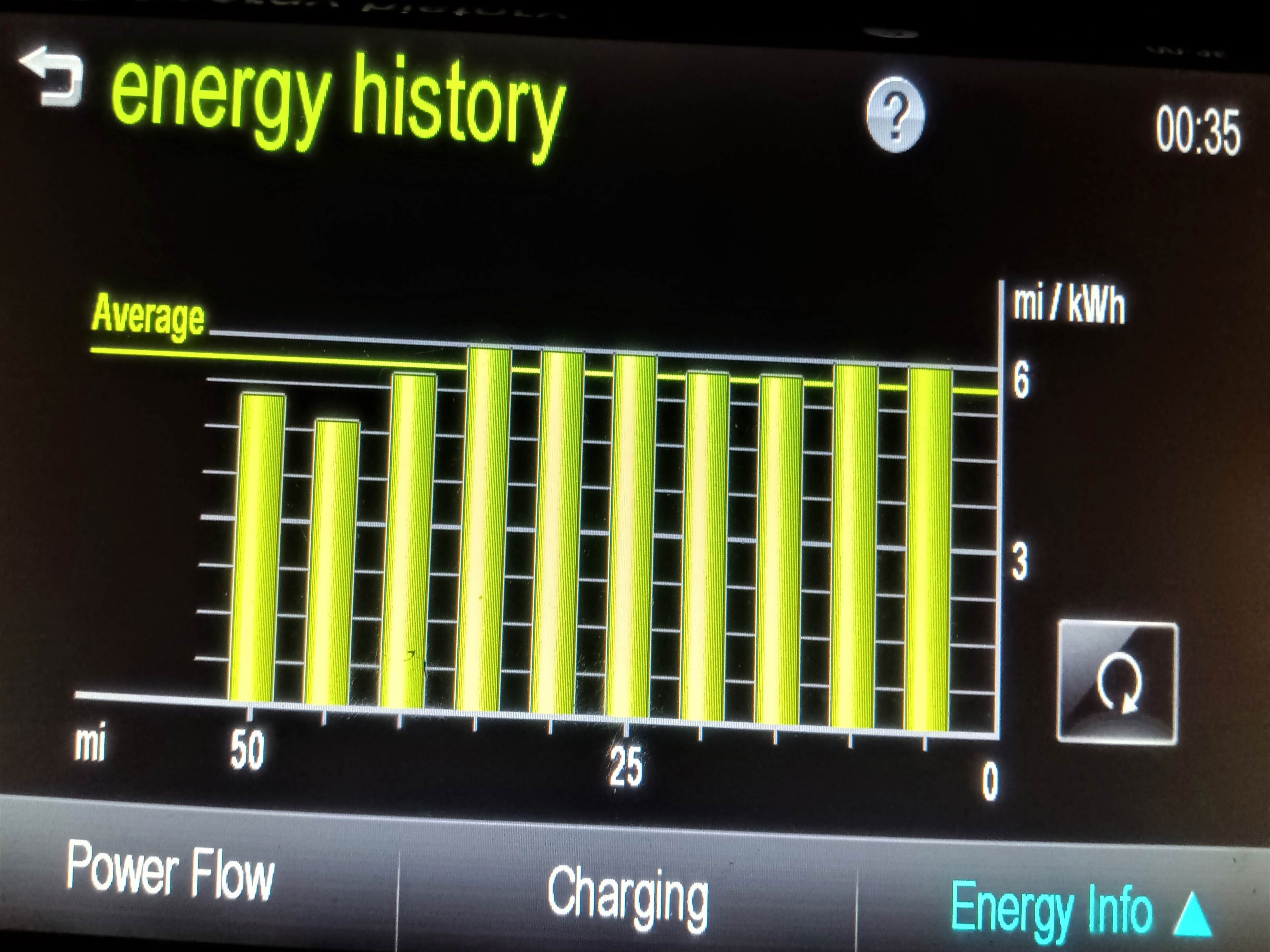
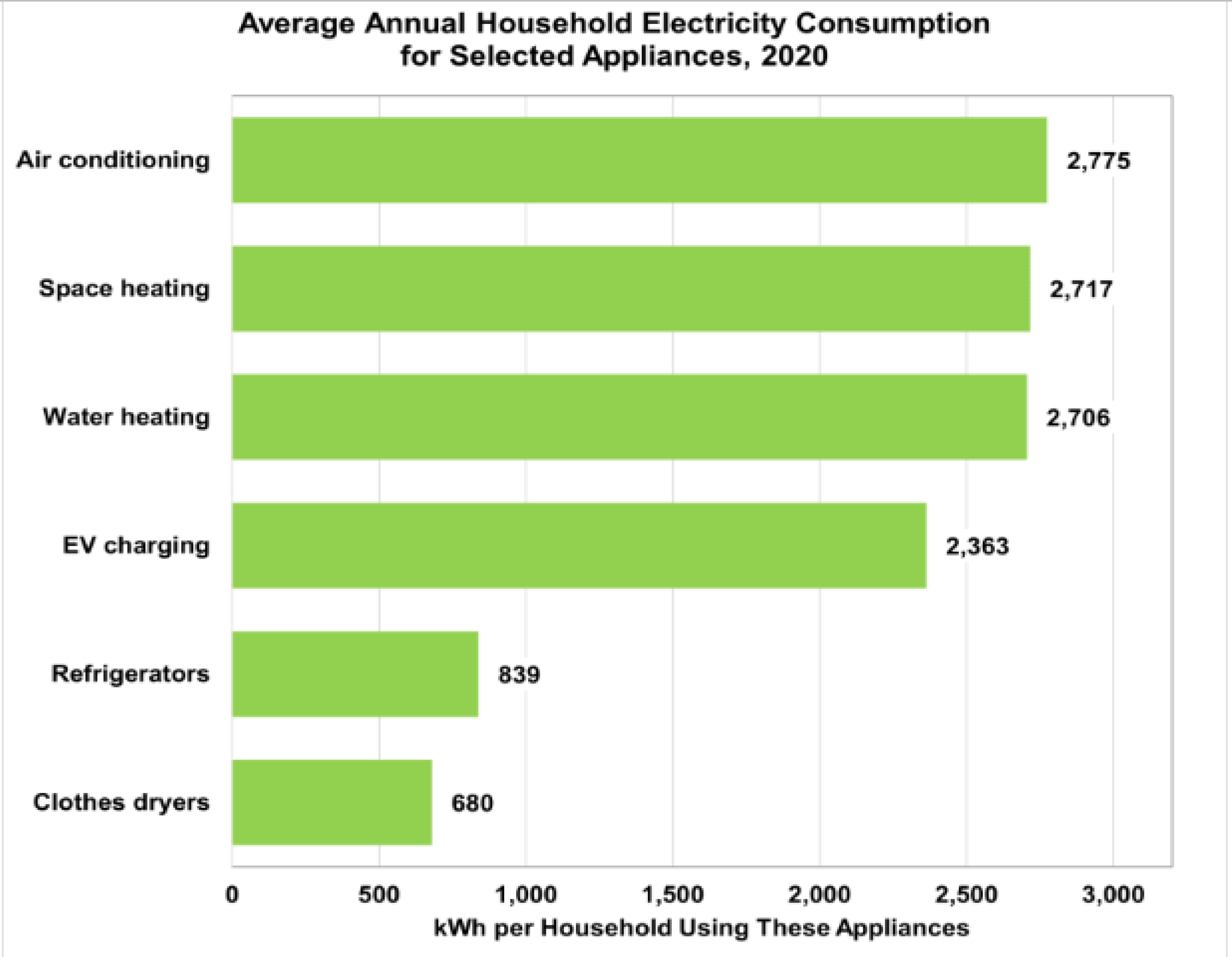
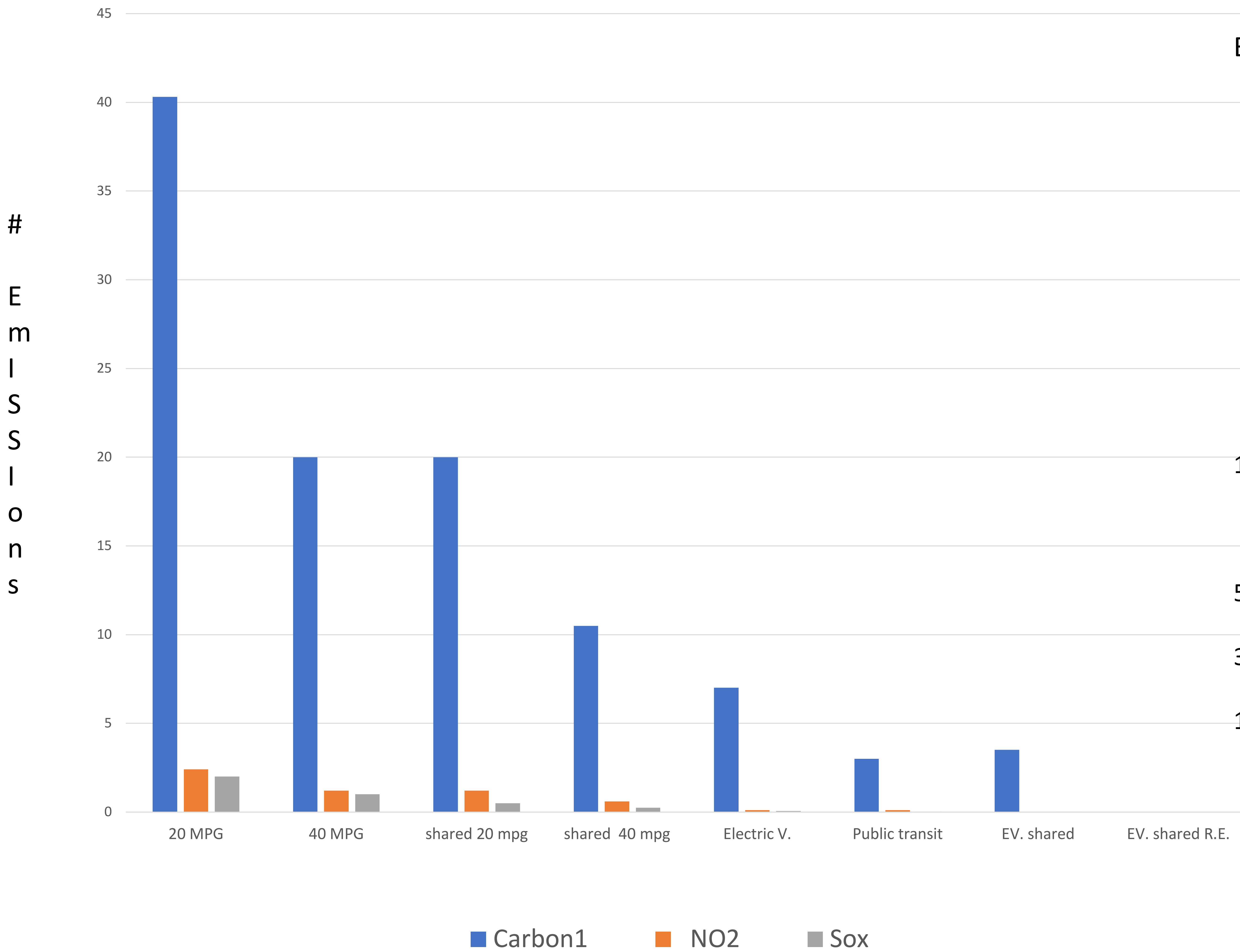
Renewable Energy Integrated
Vehicle 2 Grid


energy history
00:35
Average
mi / kWh
6
3
mi
50
25
0
Power Flow
Charging
Energy Info


Average Annual Household Electricity Consumption
for Selected Appliances, 2020
Air conditioning
2,775
Space heating
2,717
Water heating
2,706
EV charging
2,363
Refrigerators
839
Clothes dryers
680
0
500
1,000
1,500
2,000
2,500
3,000
kWh per Household Using These Appliances

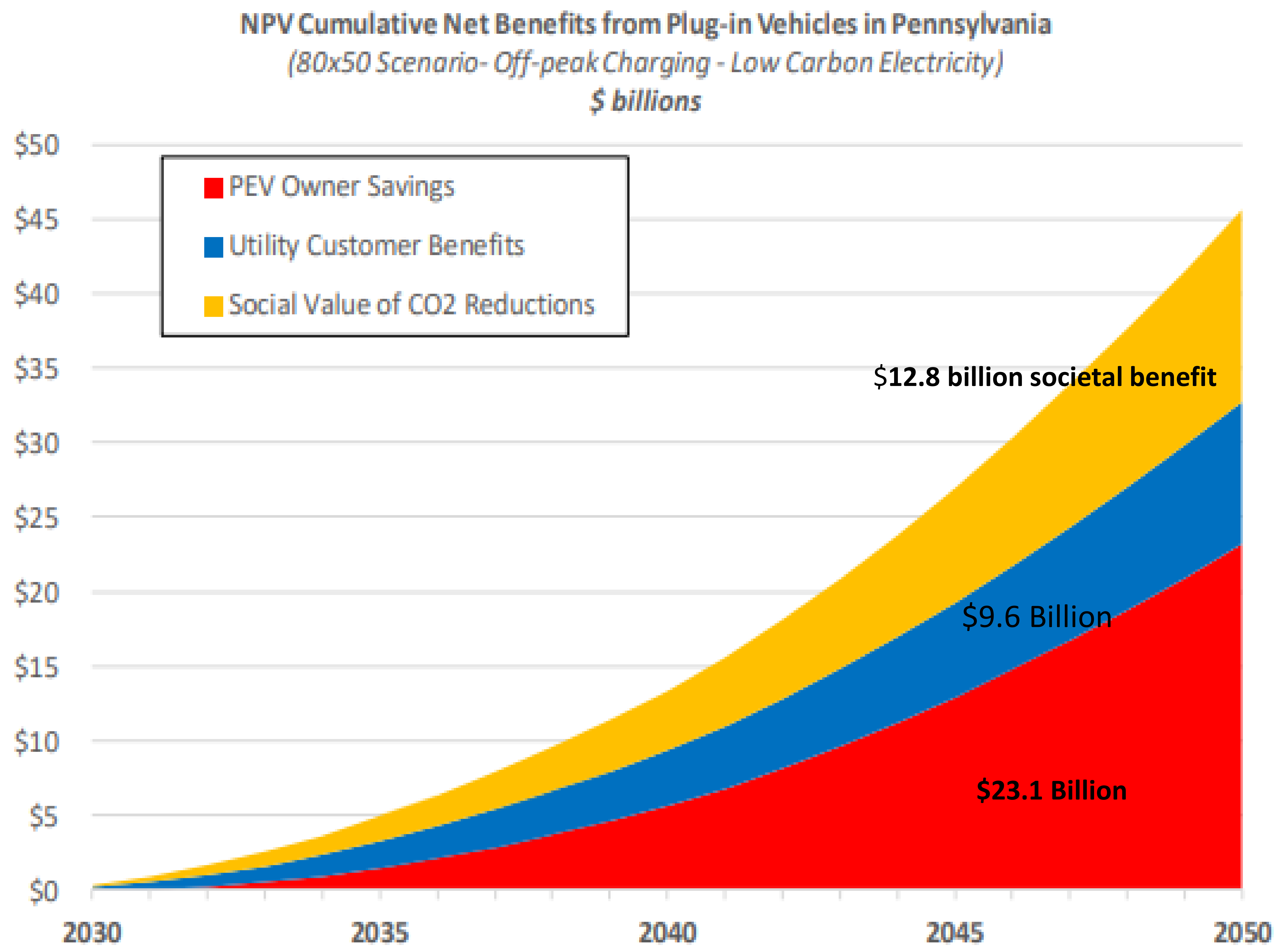
Daily 40 mile vehicle commute



Energy per Commuter

Btu	KWh
230,000	67.
115,000	33.5
57,500	16.7
34,170	10.
17,085	5.

Top 25 Metro Areas, Public Health Benefits	Cumulative Public Health Benefits 2020-2050			
	Health Benefits (Billions)	Premature Deaths Avoided	Asthma Attacks Avoided	Lost Work Days Avoided
1. Los Angeles-Long Beach, CA	$95.5	8,680	241,000	1,210,000
2. New York-Newark, NY-NJ-CT-PA	$84.2	7,660	206,000	1,070,000
3. Chicago-Naperville, IL-IN-WI	$46.5	4,230	113,000	552,000
4. San Jose-San Francisco-Oakland, CA	$42.5	3,850	113,000	561,000
5. Philadelphia-Reading-Camden, PA-NJ-DE-MD	$41.1	3,760	86,600	424,000
6. Washington-Baltimore-Arlington, DC-MD-VA-WV-PA	$38.9	3,540	104,000	516,000



NPV Cumulative Net Benefits from Plug-in Vehicles in Pennsylvania
(80x50 Scenario- Off-peak Charging - Low Carbon Electricity)
$ billions
PEV Owner Savings
Utility Customer Benefits
Social Value of CO2 Reductions
$12.8 billion societal benefit
$9.6 Billion
$23.1 Billion
$50
$45
$40
$35
$30
$25
$20
$15
$10
$5
$0
2030
2035
2040
2045
2050

Vehicle Charging Impact on PJM

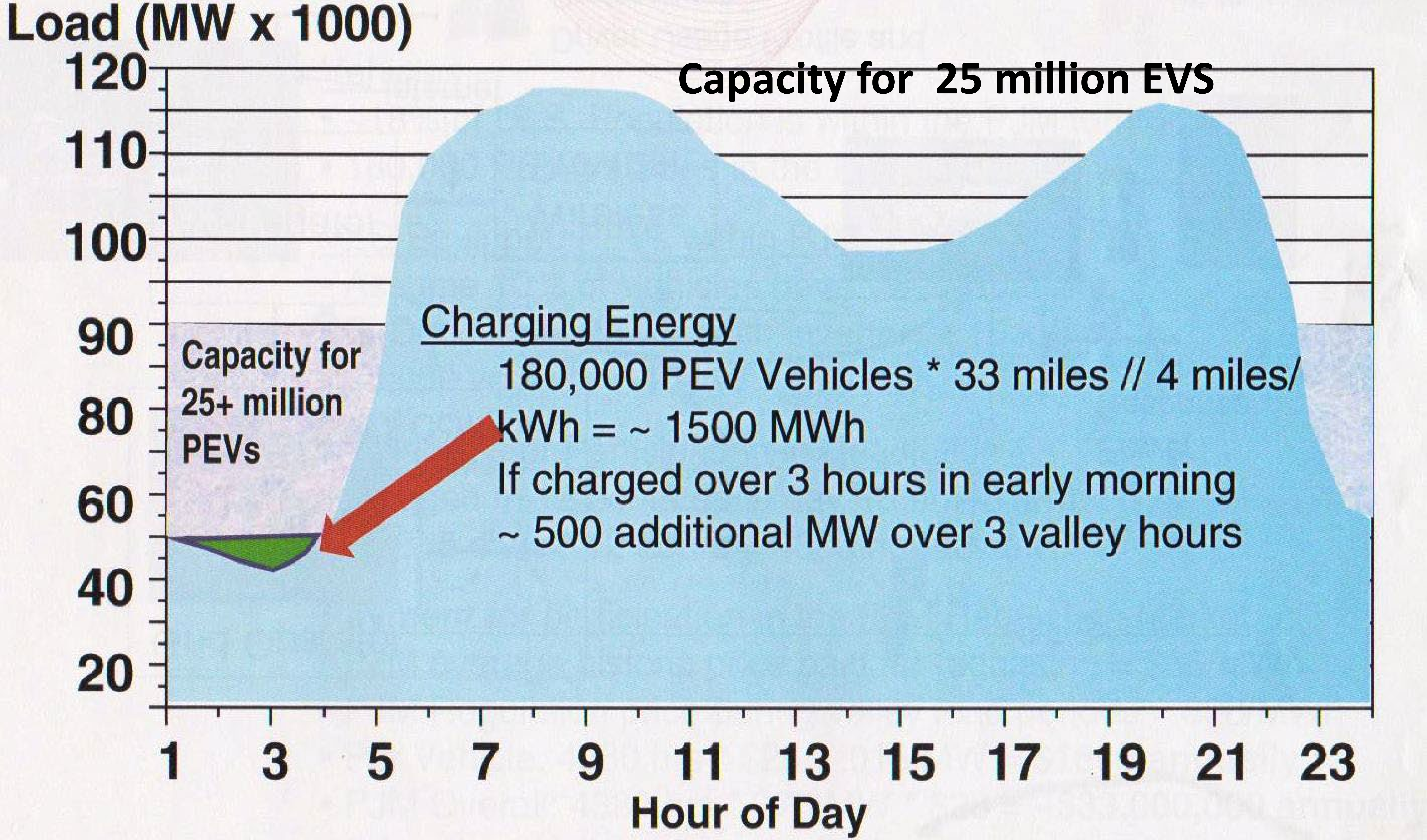
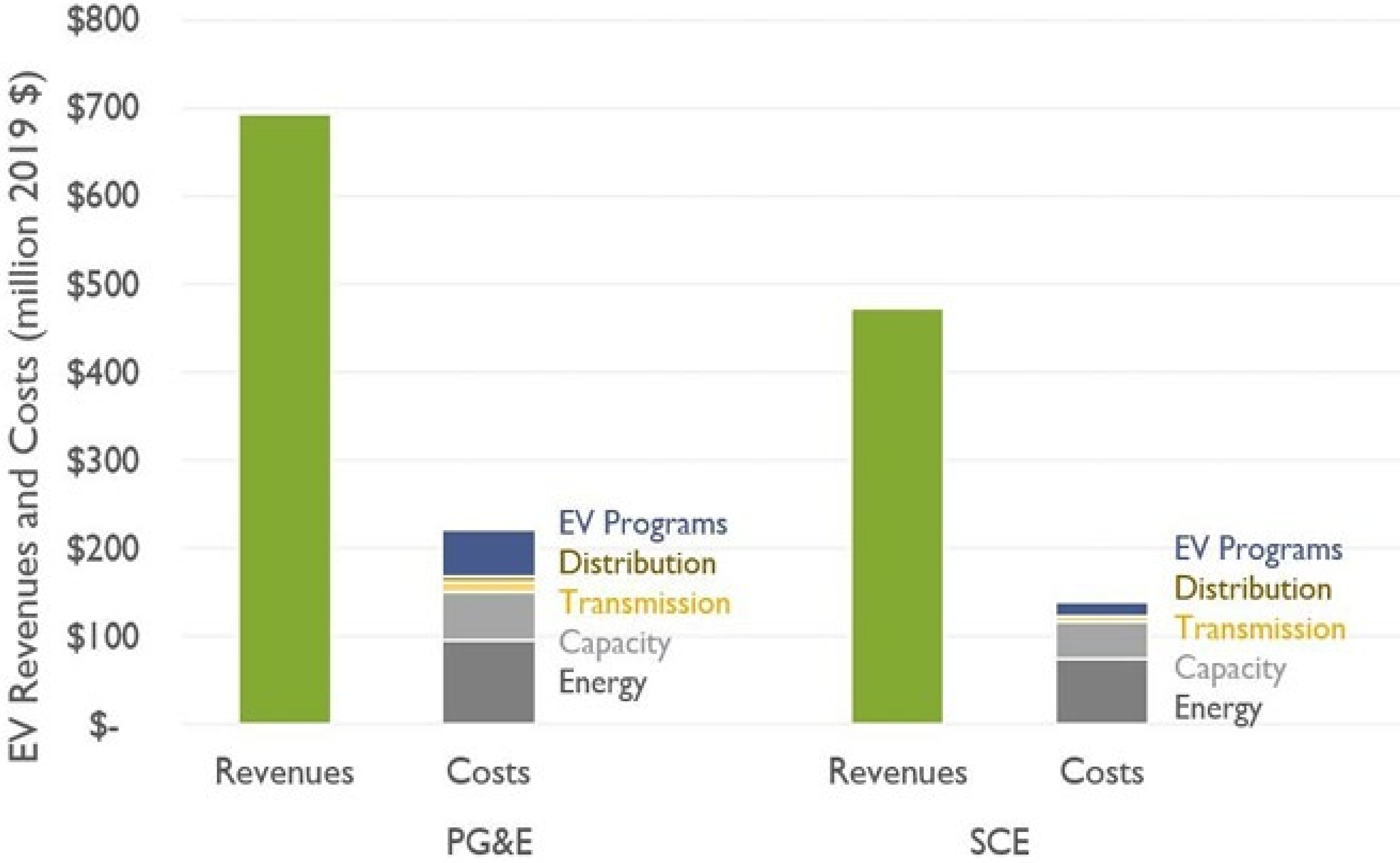


Figure 4. PG&E and SCE Revenues and Costs of EV Charging, 2012-2019



2012 – 2019 revenue net costs from EV drivers in PG&E & SCE $806 million

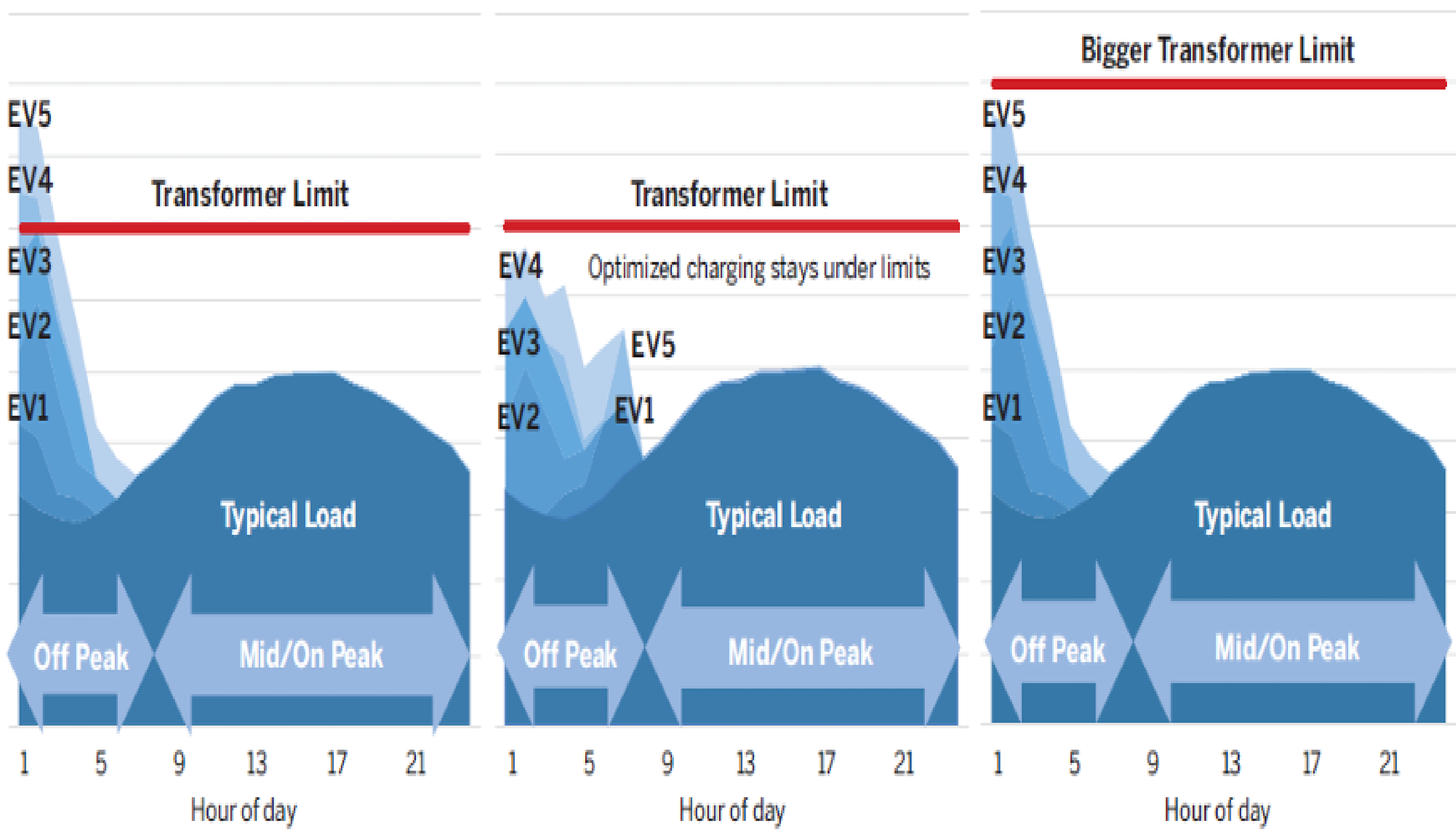
EV_Impacts_June_2020_18-122.pdf (synapse-energy.com)

Embrace Smart Charging:

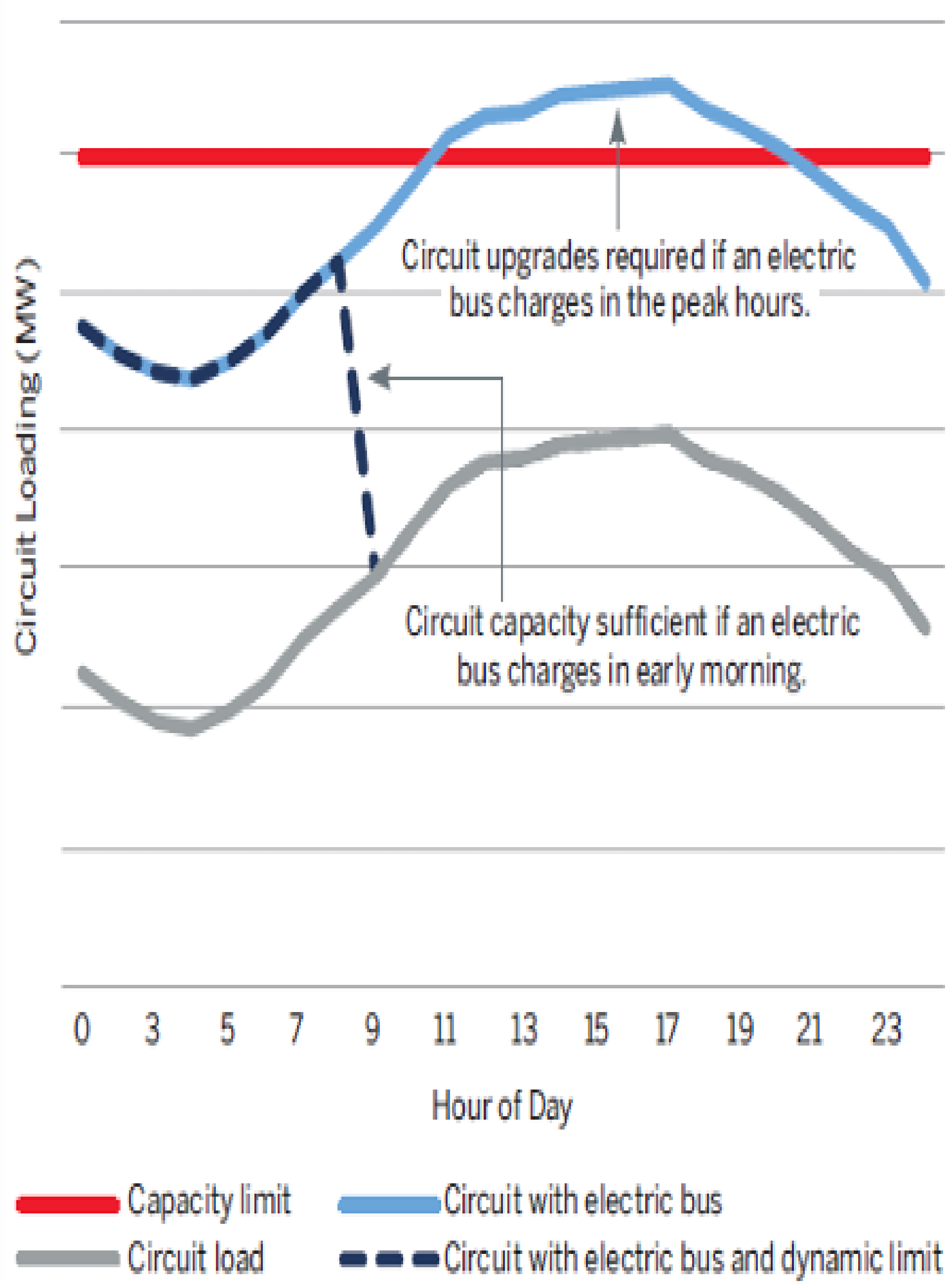
Can address multiple grid needs simultaneously

ESIG

Care should be given to avoid unintended consequences in the design of programs, with costs evaluated against traditional upgrades



Managed charging allows dynamic operating and interconnection limits with restrictions on when the EV can charge.



Network Providers with OpenADR

Amply	EverCharge	Mobility House, LLC
AmpUp	EvGateway	Noodoe
Blink	EVSE LLC	OpConnect
Chargie LLC	FleetCarma	PowerFlex Systems
ChargeLab	Flo	PowerTree Services
ChargePoint, Inc	Green Charge	SemaConnect
Driivz Ltd.	Greenlots / Shell	Siemens
Electriphi	Gridscape	Tellus Power, Inc
Enel X	Innogy SE	ZEF Energy Inc.
EV Charging Solutions Inc	KiGT Inc	Zero Impact Electrical
EV Connect	KnGrid/Oxygen Initiative	Zevtron, LLC

Managed Level II EV Charging at 13th Street Philadelphia Navy Yard

The number of times a charging session that fulfills the driver's energy need can be completed within their dwell time:

$$Flexibility = \frac{kW_{EVSE}}{\frac{kWh_{Needed}}{h_{Depart} - h_{Plugin}}}$$

If Flexibility < 1, driver's mobility need is violated.
If Flexibility = 1 minimum charging can be completed.
If Flexibility ≥ 2, multiple sessions and DR are feasible.

Philadelphia Navy Yard Commuter fleet

Internal combustion Vehicles Switch to Electric Vehicles (EV)

ICE-V		EV
10,000	Vehicles	10,000
28	Miles / day	28
280,000	total miles/day	280,000
220	days per year	220
61,600,000	Total miles/ year	61,600,000
25	Energy Efficiency	117
2,464,000	Gallons per year	526,496
82,544,000	kWh / year	17,637,607
283.360	Billion BTU	60.547
$3.2gallon	Energy unit costs	$.18 kWh
$7,884,800	Energy $/ year	$3,174,769
24,147.20	GHGe tons GHGe PJM	7,055.04
	GHGe PV	0
$50	Social $ Carbon/ton	$50.00
$1,207,360	Gas $ GHGe PJM	$352,752
	cost GHGE PV	0
$9,092,160	Gas Energy + GHGe PJM	$3,527,521
	Energy +GHGe PV	$3,174,769

$5.9 million year in commuter energy savings.

$590 energy savings/vehicle/year


EV Charging Hubs located in microgrids to optimize
economic, energy & emissions performance

Reduce Charging Hub demand, distribution and standby utility charges by microgrid and utility planning to orchestrate DER to optimize EV charging economic performance.

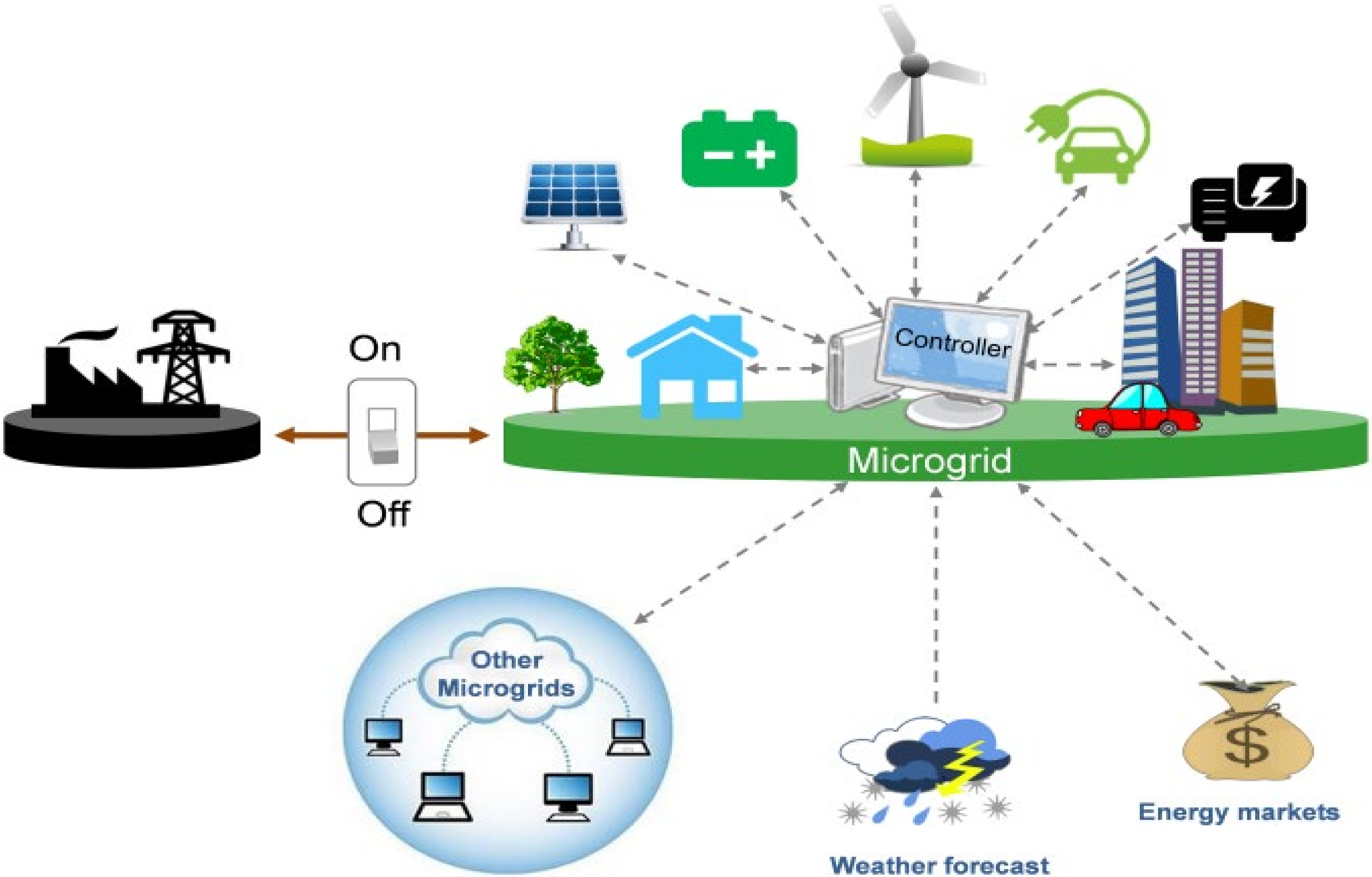
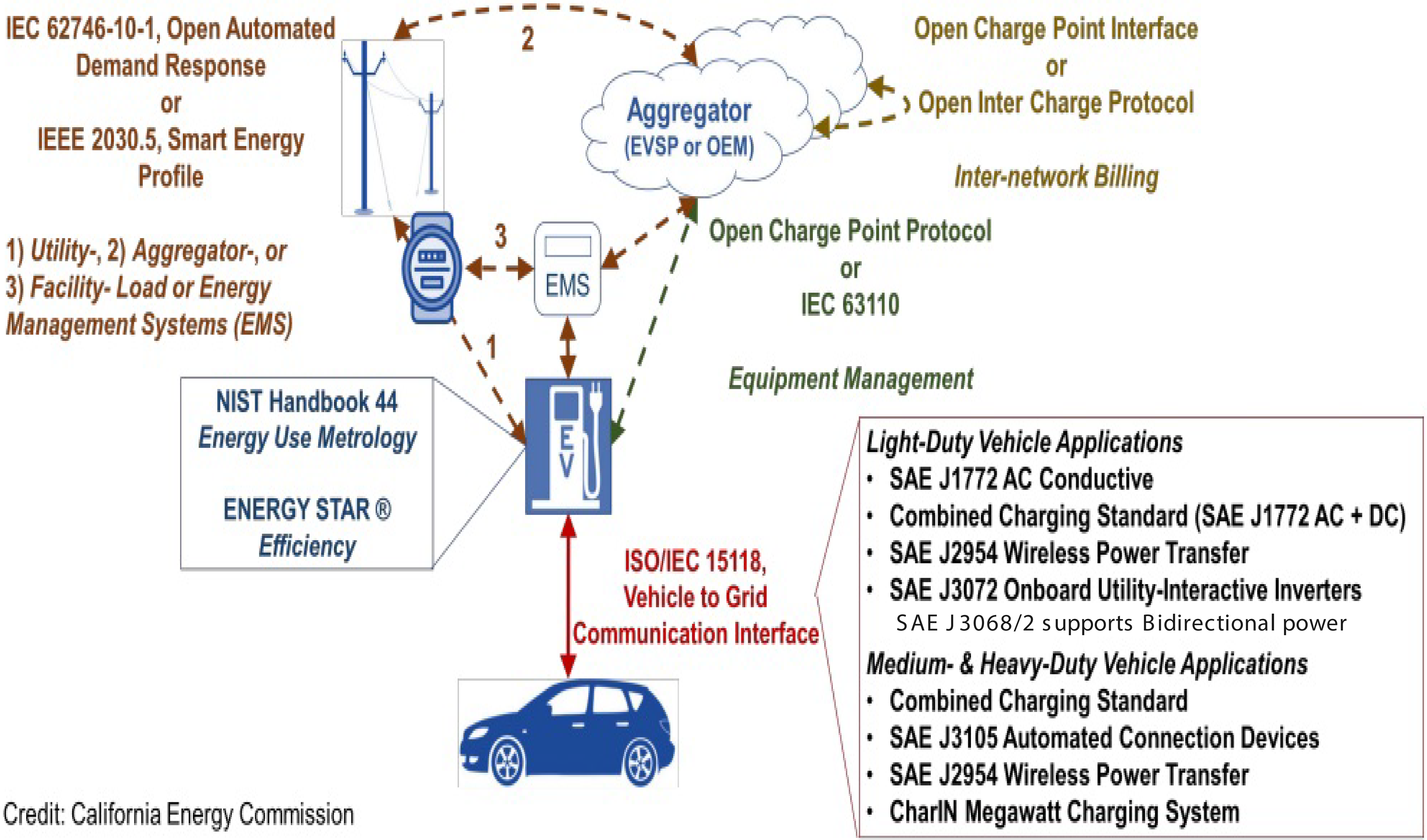


Figure 21: Grid-Integrated Charging Equipment Design Archetype



Credit: California Energy Commission

Interoperable charging hardware is critical to a charging experience that is user-friendly and grid-responsive. ISO 15118 provides a standard vehicle-charger communication language, while OCPP provides a standard charger-network language. Widespread deployment of chargers that "speak" these languages will ensure that California is prepared for vehicle-grid integration, as well as future vehicle and charger features.

Source: CEC

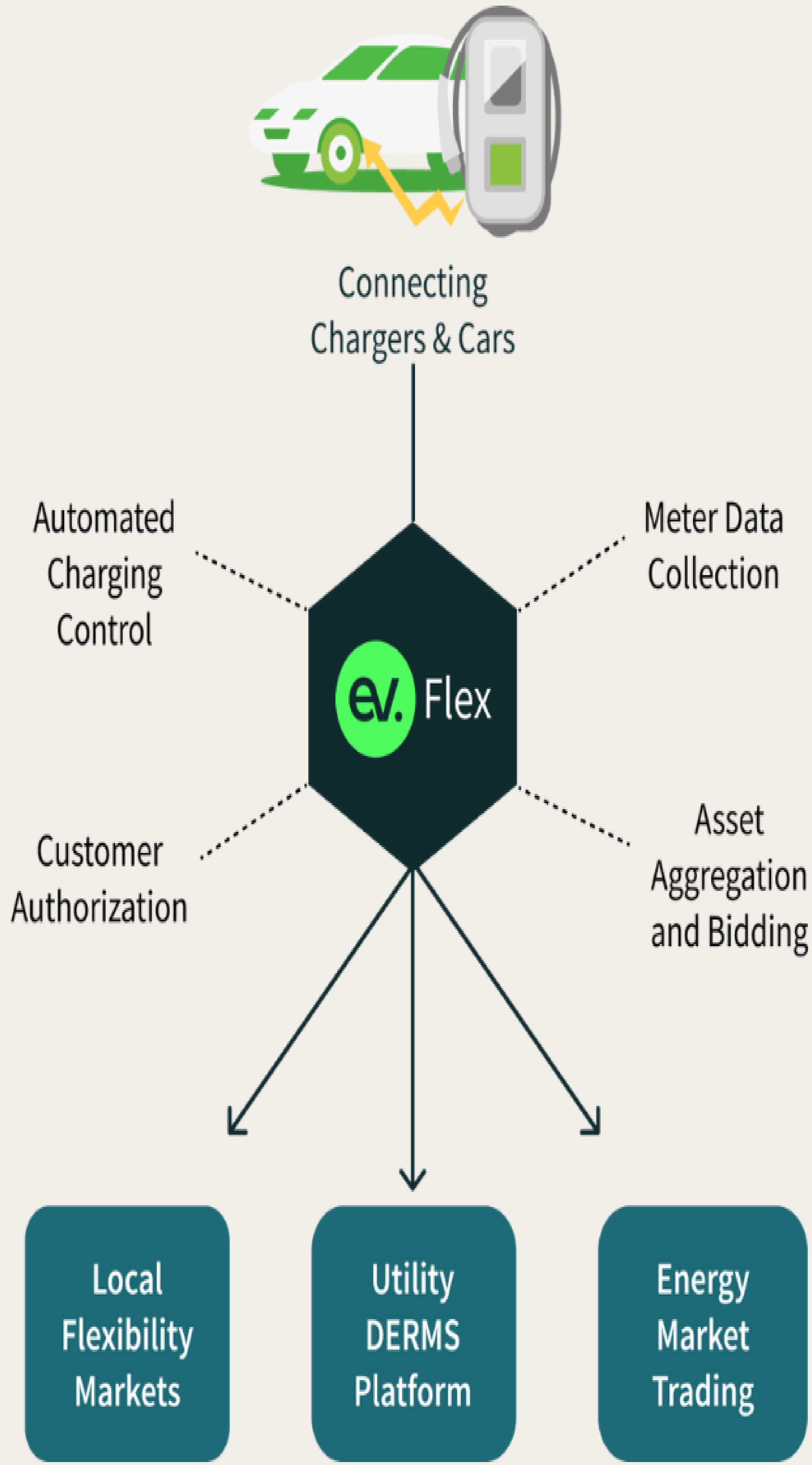
Plug and play

Plug your DERMS into ev.energy with our API

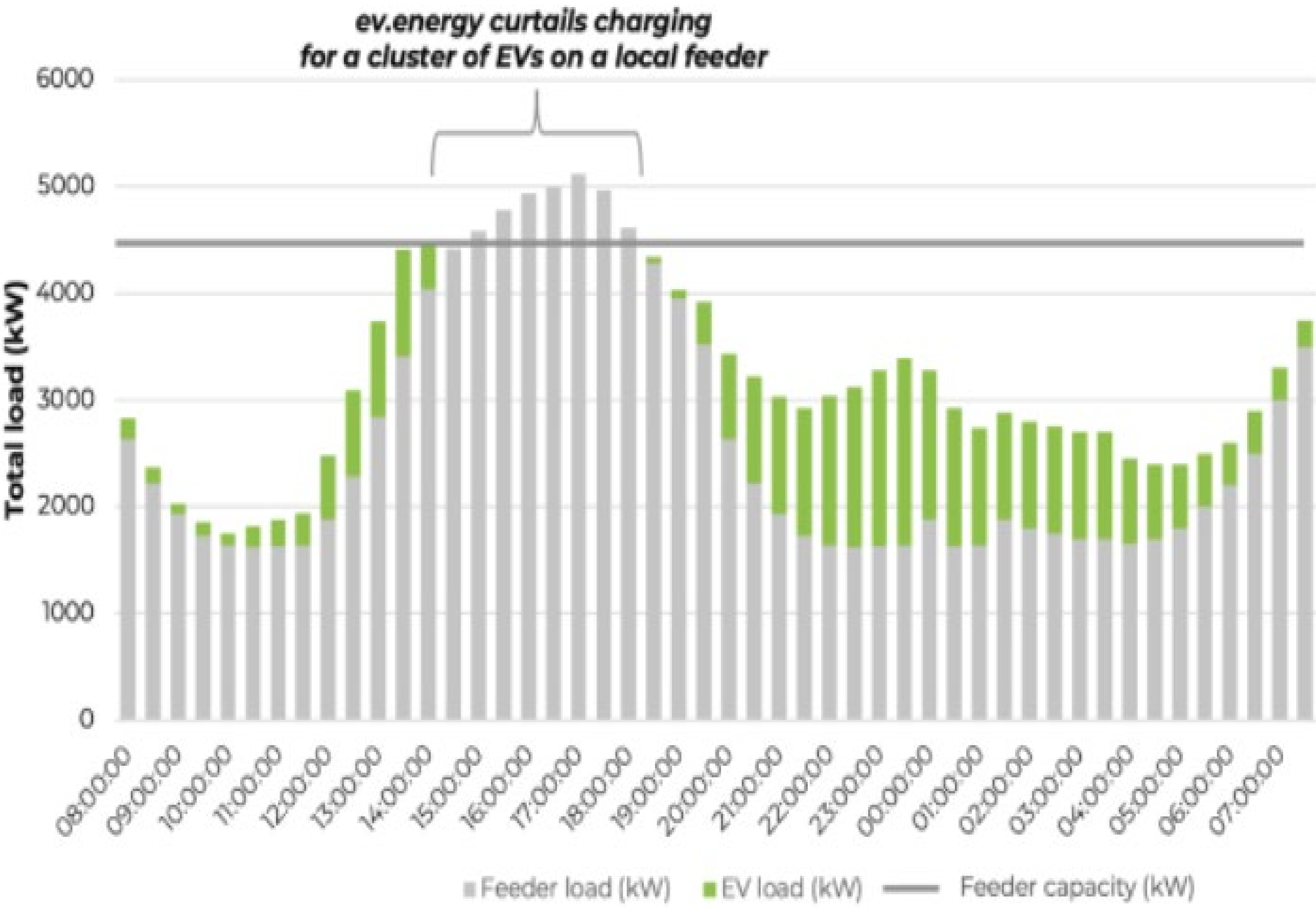
ev.energy's Virtual End Node (VEN) API can plug into any DERMS with ease, actively managing EV charging in line with commands from the DERMS and passing back current and forecasting charging loads for system-wide optimization

Curtail or throttle EV charging

In response to dispatches from a DERMS, ev.energy can fully curtail EV charging or alternatively throttle the charging down to a lower power level to keep demand within local network limitations.



Example thermal constraint event: July 26th, 4pm-8pm

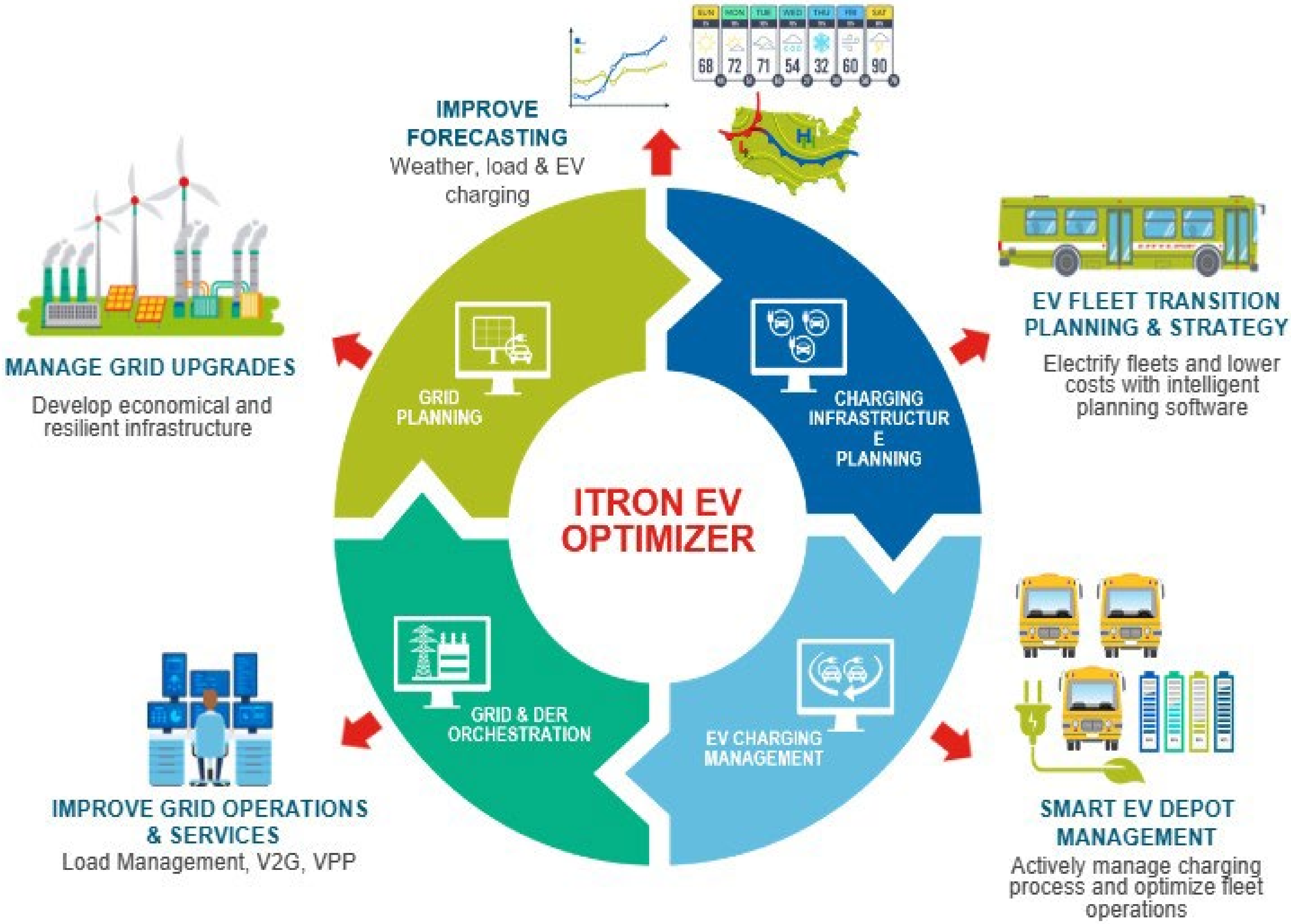


Costco off Grid DC Fast Charging with onsite: BESS, PV and CHP

Team of Teams Integrated DER Planning is essential to optimize EV operational and Economic Efficiency

EV Management Solutions

An integrated platform for the Energy & Transportation Ecosystem



Renewable Energy Integrated Vehicle 2 Grid

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