MHDV MFR-Order Straw Proposal: Panels

The Synergy Between Vehicle Charging And Renewable Energy and Storage

September 21, 2021

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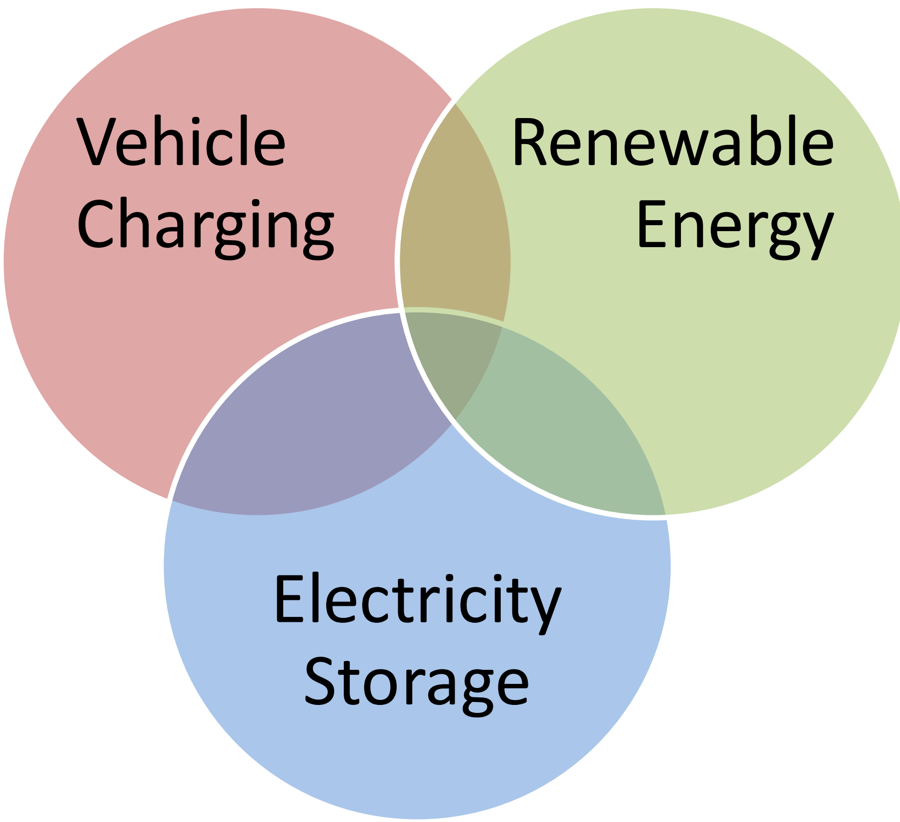
Parallel Strategic Initiatives

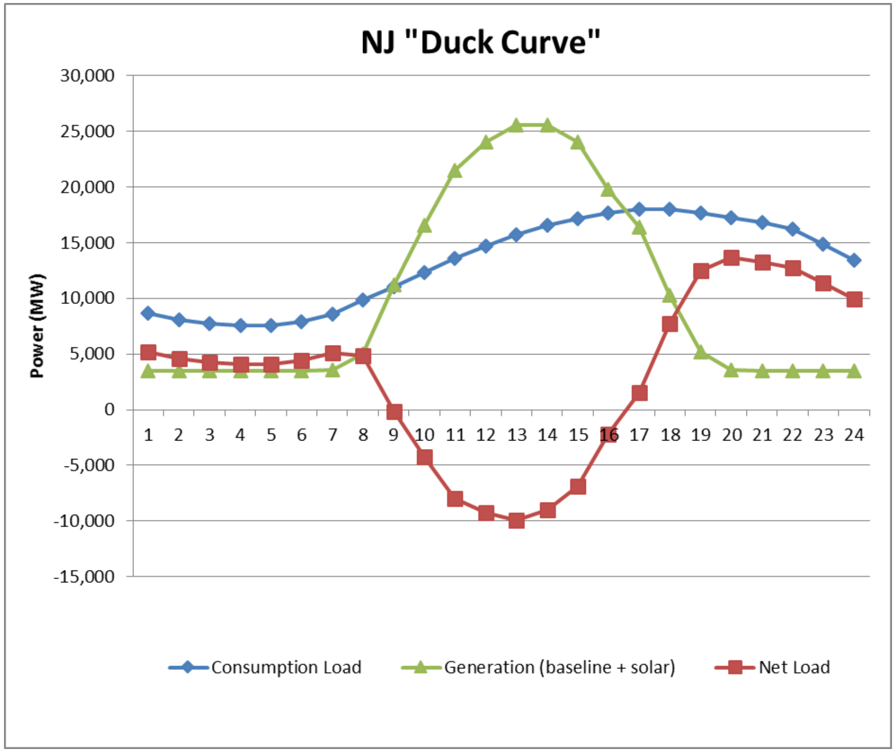
Vehicle Electrification Is Not Happening In A Vacuum – It Is Taking Place In Parallel With Other Strategic Commitments To Renewable Energy And Electricity Storage.



In This Context, EV Adoption Is About Much More Than Moving Vehicles With Electricity:

- It Is A TRANSFORMATIVE Technology That Will Drive Synergistic Changes In The Grid
- The Make-Ready Element Is Not Just About Enabling Charging – It Is Also About Mitigating Grid Impact And Reducing Costs

Vehicle Charging And Solar Energy Synergies



Based on 2015 NJ Load Curve, 30 GW of Solar, 3.5 GW of Baseload Generation (nuclear)

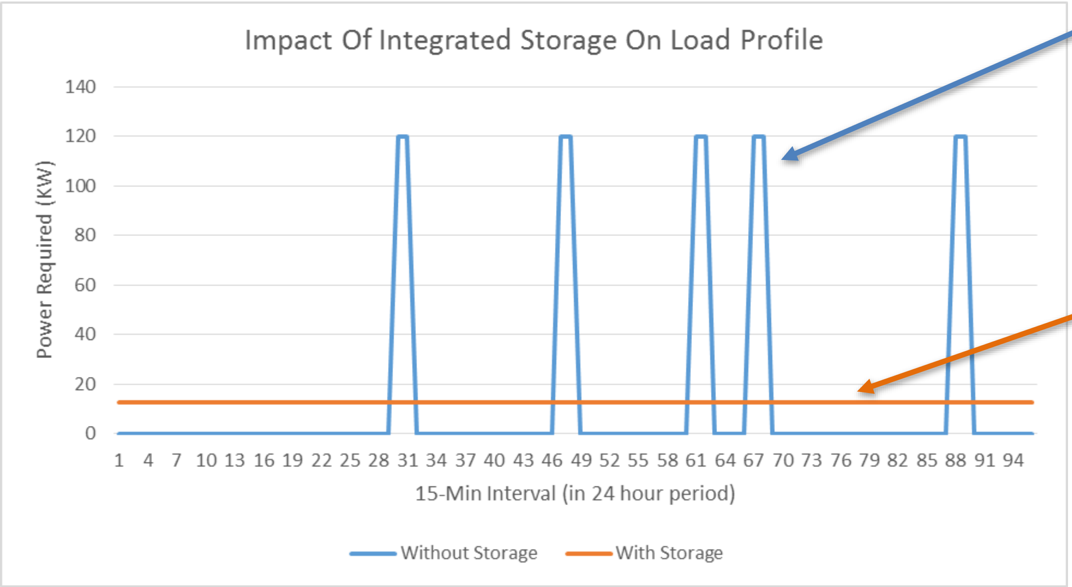
- **High Levels Of Solar Use, As Required By New Jersey Clean Energy Goals, Creates Two Problems:**
  - Erratic Ramping Of Dispatchable Generation
  - "Excess" Solar Generation During Peak Times, And Not Enough Solar Generation Overnight
- Vehicle Charging Can Enable A High Renewable Energy Fraction, Shift Generation In Time, And Avoid Excessive Generation Ramping.
- **Applies To Both Solar And Wind**
  - **Workplace and Fleet Charging For Solar**
  - **Night-time Residential Charging For Wind**

Creating A Synergy Between EV Charging And RE-Use Will Only Happen If We Design The Market To Achieve That Outcome.

It Is Important That MFR-Straw Covers MHDV and Fleet-LDV.

Storage Will Be An Enabling Technology For Charging

Storage Integrated As Part Of Charging Infrastructure Has Two Impacts:



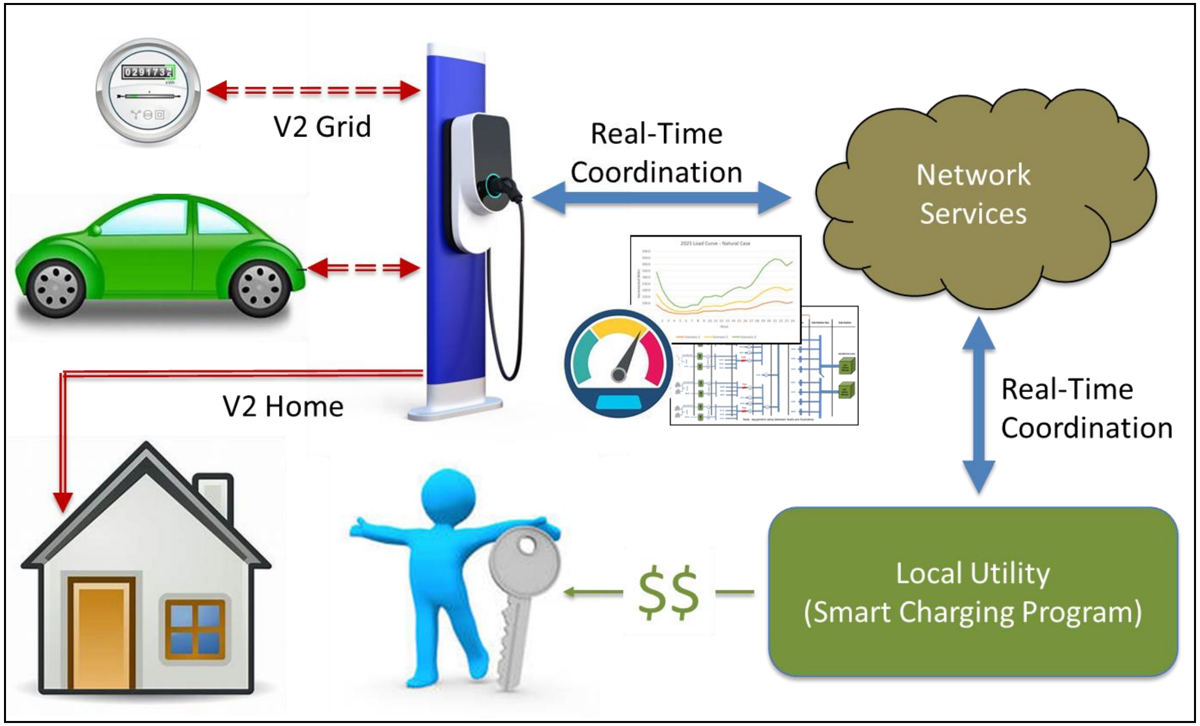
This illustrative example: deliver five 120KW charges, at 60 kwhr each, needs 12.5KW "trickle load" if there is integrated storage.

- Mitigates peaking impacts on the distribution system, transmission, and wholesale energy markets.
- Lowers power requirements, enables projects that would be difficult under BAU conditions.

Especially Critical For Fleet Applications (where charging loads are concentrated), and MHDV (which may require very high power charging). **Consider As Part Of Make-Ready Program Design**.

Electric Vehicles Becoming Advanced DERs

Vehicle Charging Is Becoming Bi-Directional:



- V2H Can "Power A Home" When The Grid Is Down
- V2G Can Enable EV-Batteries As DERs (Distributed Energy Resources) That Can Offset Peak Load
- Aggregate Impact Of V2B Of Fleet Vehicles Is Significant

Crowding In Private Capital in Support of Electric Mobility

September 21, 2021

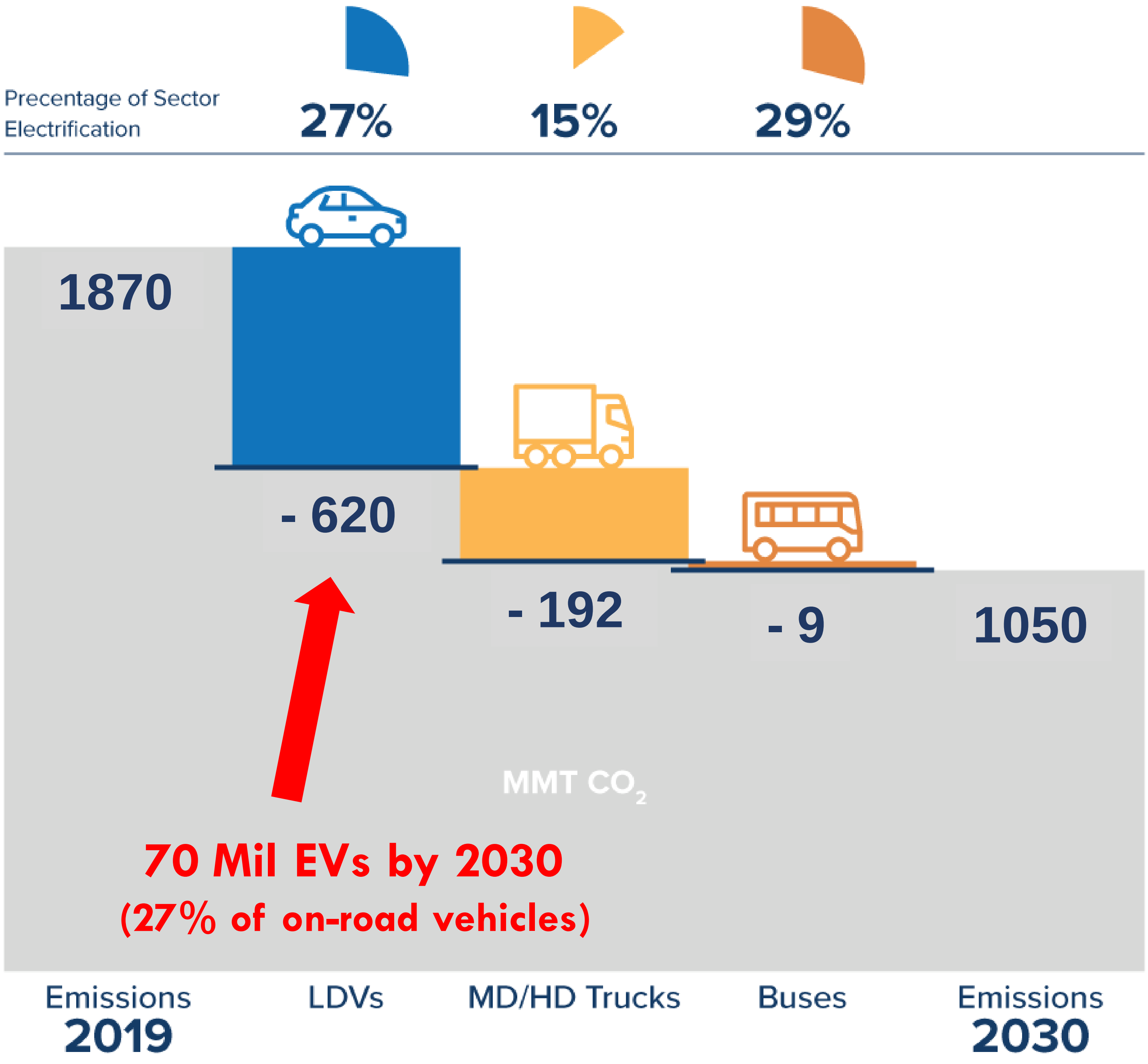
NJ BPU

Chuck Ray / RMI Carbon Free Mobility

US transportation emissions must decrease 45% by 2030 to align with a 1.5ºC target

Also requires a 20% reduction in vehicle miles traveled (VMT)

Each MHD bus/truck electrified
has the same impact
as taking 25 cars off the road.

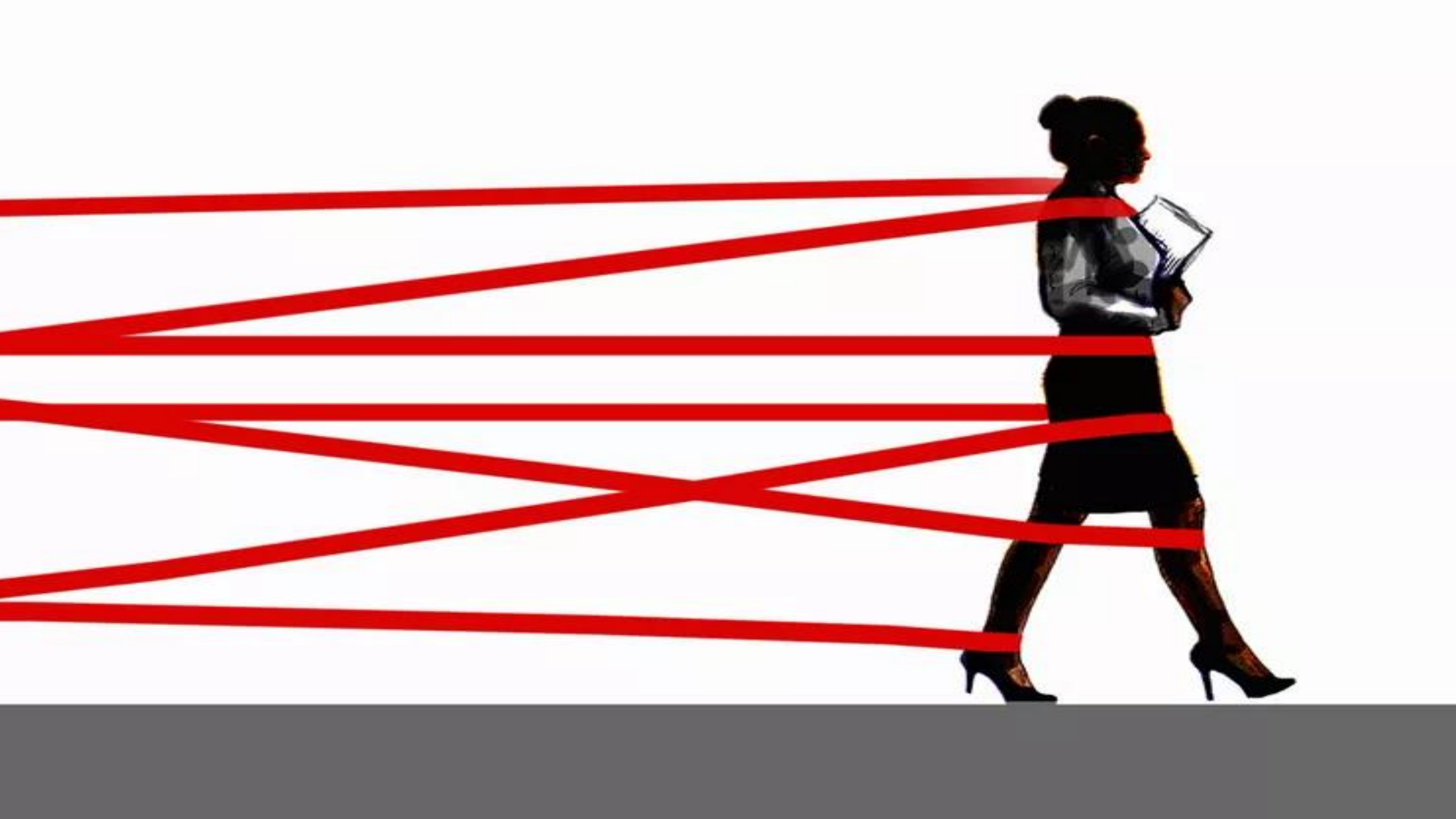


Speed of EV deployments is essential

(consider fleets, their high mile use cases, and where they operate)

- Every ICE purchase locks in emissions for 15 more years
- Buses and shuttles operate almost continuously, amplifying the benefits of zero emissions with every mile driven
- Trucking is a significant contributor to bad air quality, and is also concentrated in urban areas and corridors
- Electrifying MHD is intrinsically equitable, and should be the first focus of transportation electrification investment programs

The last MHD ICE procured is when the clock starts, not the first EV.



Relying on federal, state, and utility grant and rebate funding is a slow approach

- Competitive grants require submitting applications, and waiting for decision before any next step procurement activity; when grants are not approved the next step is to recycle and look for more grant monies
- Competitive grants can be a nice-to-have not a need-to-have

Private capital can be acquired relatively quickly, and leverage public funds 1:5 ratio

Leveraging private capital through Public Private Partnerships or Project Finance

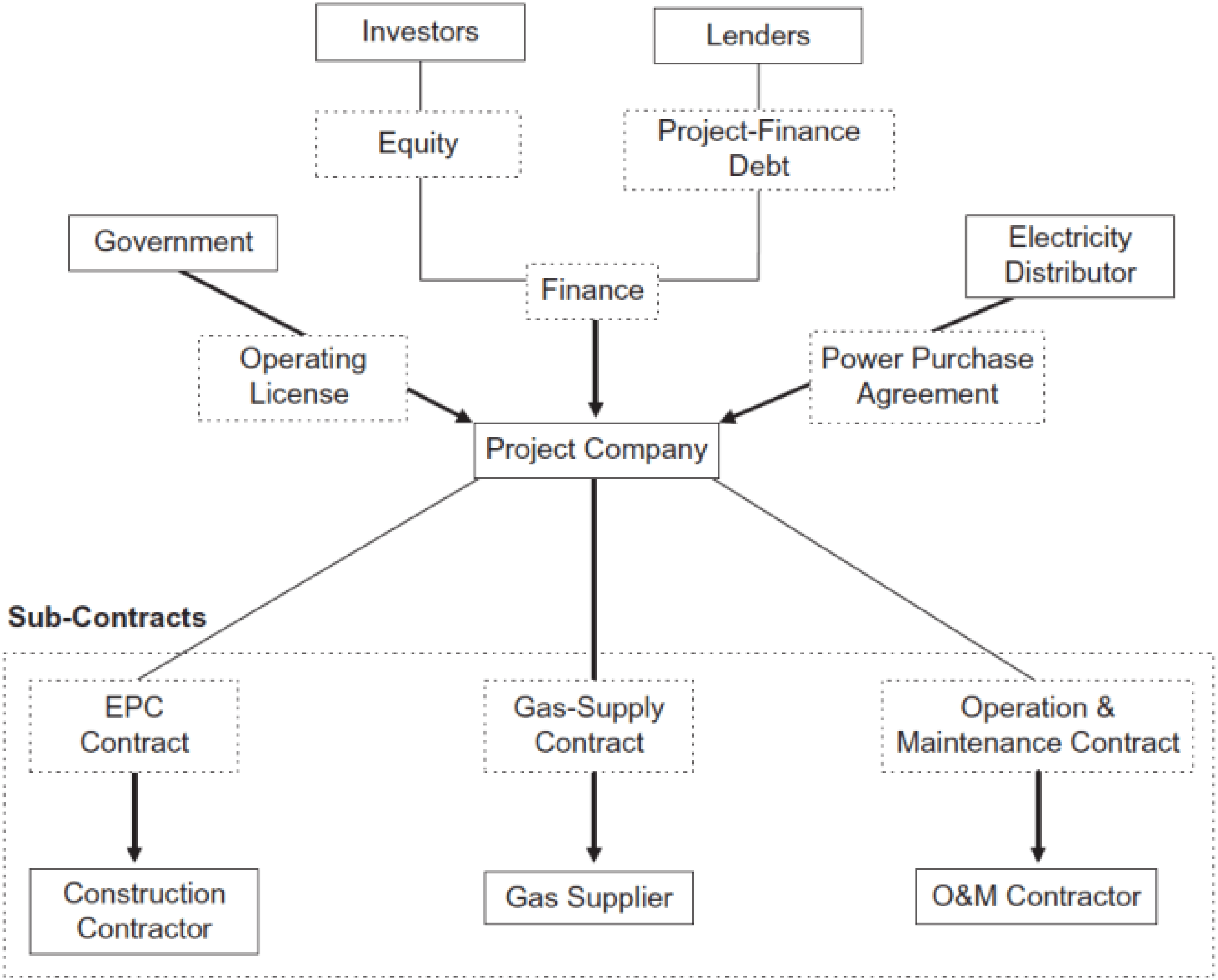
- P3s at the $10-100M level
- Grants, rebates, green banks can be used in blended finance to lower capital risk
- Project finance requires “project company” to encompass all elements of business to deliver guaranteed service

Project finance approaches address design, engineering, construction, and operations in a single project

Project Companies / Asset Owners

- Aggregate all financing
- Engineer / construct / commission / operate / guarantee service
- Leverage public monies with private capital
- Accelerate time to operations
- Provide flat price of electricity
- *Remove operational risks

Needed:
Turnkey or XaaS procurement on the demand side
Performance incentives on the supply side



Turnkey services accelerate deployments and removes risk

- Emerging technology is unfamiliar, requires new skills, and causes understandable hesitation to move too quickly
- Relying on third parties whom serve many clients solves the knowledge gap
- Relying on third parties with revenue motivation guarantees on-time on-budget
- As-a-Service (XaaS) offerings include service guarantees which removes risk

Fleet-as-a-Service; Charging-as-a-Service; Energy-as-a-Service

Performance Incentive Mechanisms can align objectives and speed

- Determine what role PIMs can play in supporting public policy goals (including distributed energy and resilience)
- Consider how PIMs can support utility growth into new service areas (either as owner/operator service grantor or microgrids)
- Align incentive structures with expected benefits
- Prioritize flexibility and learning

Approved spending over some number of years is insufficient motivation; use-it-or-loose-it is only a partial answer

Needed:
Performance incentives with the metric of steel in the ground rather than service offerings alone

NJBPU can establish the next level framework beyond “make-ready” utility investments

Chuck Ray / RMI Carbon Free Mobility

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Renewable Energy, Storage, and Vehicles as a Grid Asset

Presentation for NJBPU stakeholder panel (September 21, 2021)

Pamela MacDougall, PhD
Senior Manager, Grid Modernization and Charging Strategy

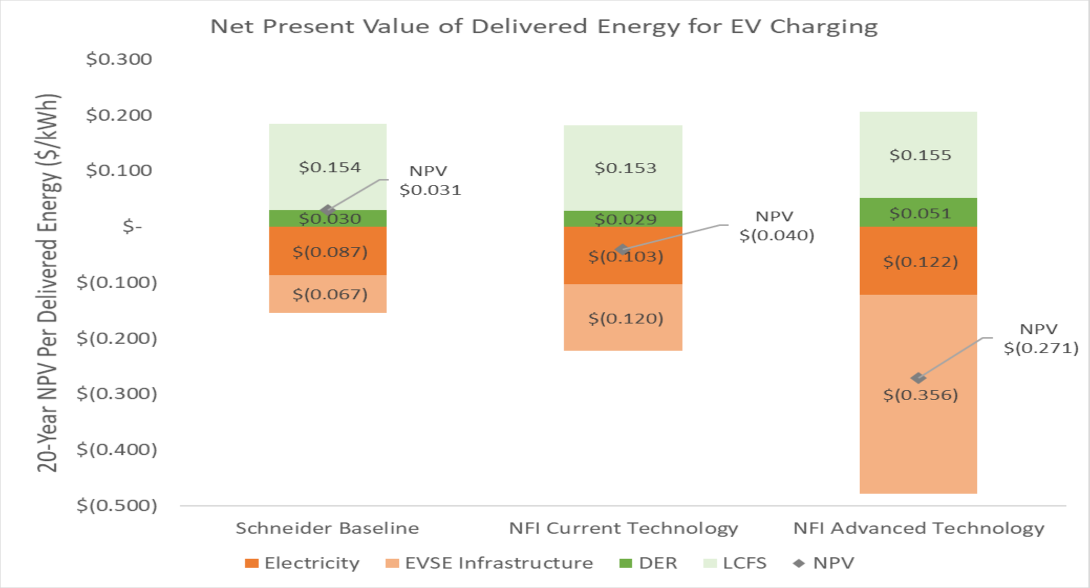
EDF
ENVIRONMENTAL DEFENSE FUND®
Finding the ways that work

Importance of Storage, Renewables, and Smart Charging for MHDVs

Renewables and Storage offer many benefits to Fleets:

- Aid in Electricity Bill Reduction
- Bring down TCO of charging infrastructure.
- Minimize behind the meter make ready buildout.
- Provide Power Security for Fleets

Example of BESS impact of Class 8 Fleet in California



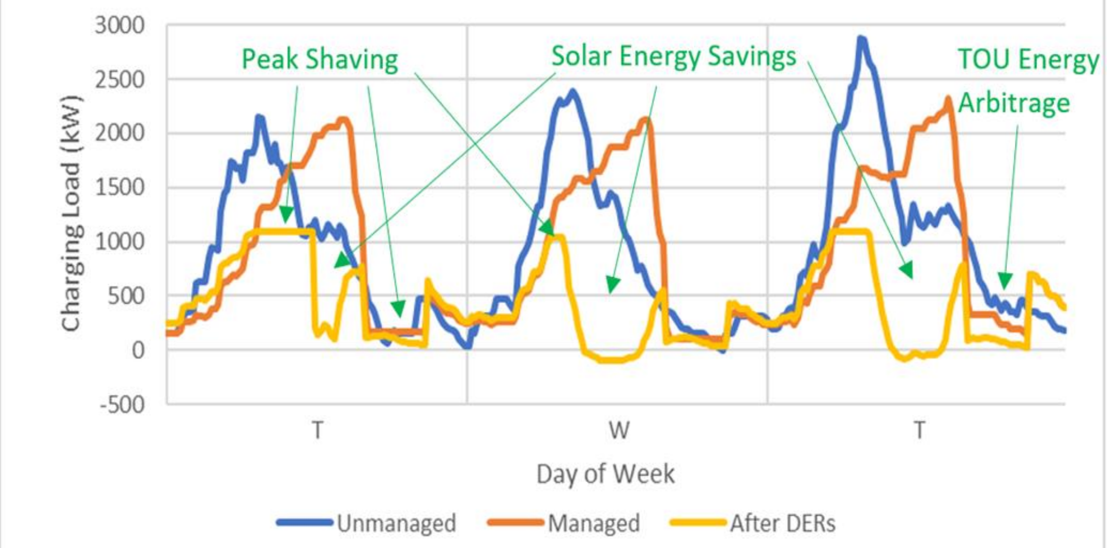
Evaluated Charging Infrastructure Costs for Two fleets:

- NFI – 50 Trucks
- Schneider – 42 Trucks

The **ONLY** positive net present value scenarios were those including solar and storage.

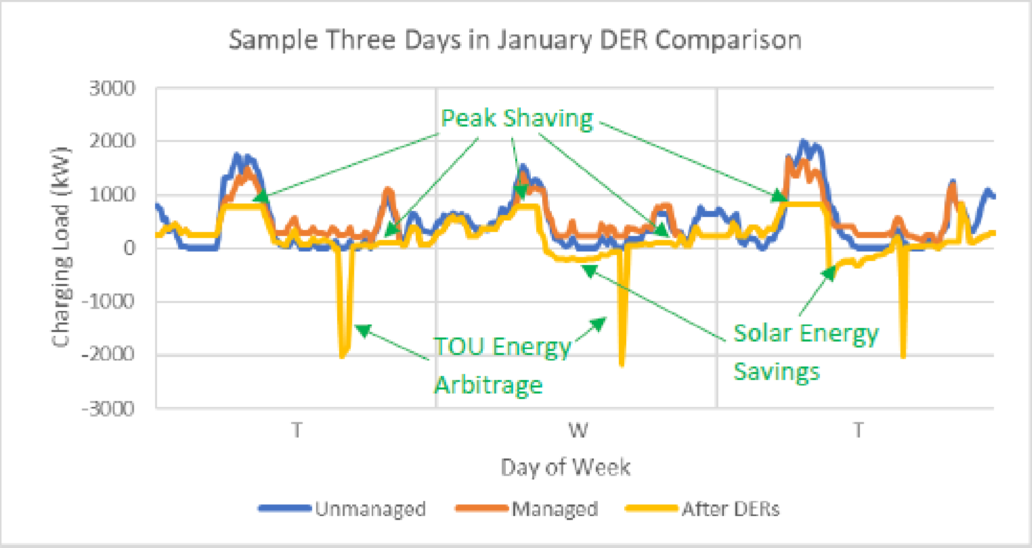
For More Information See Here

Example of BESS and Managed Charging to Lower Cost of Charging



Scenario	Energy	Demand	Fixed	Total Bill	Total DER Savings
Current Technology DER $2/W	$42,521	$174,190	$3,061	$219,771	$433,648
Current Technology DER $5/W	$167,902	$239,441	$3,061	$410,404	$624,281
Advanced DER $2/W	$57,286	$256,206	$3,061	$316,552	$1,016,746

Smart Charging and DERs are Important for Utilities

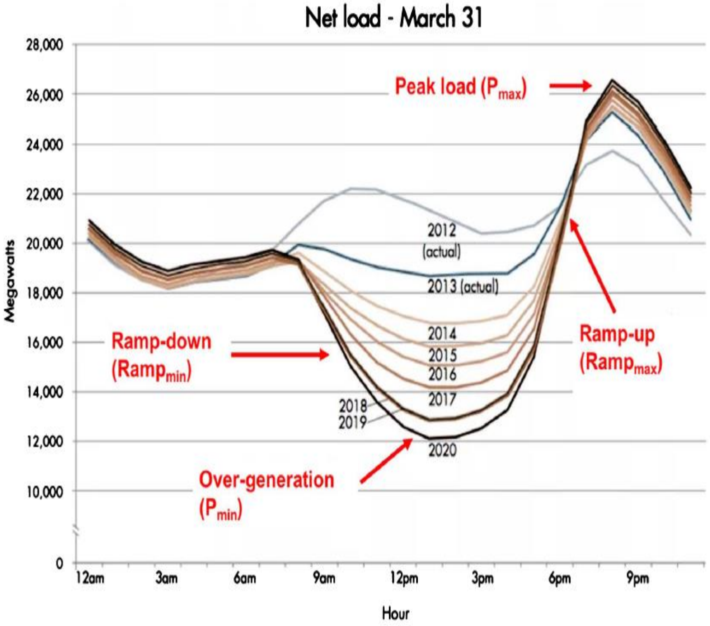


Scenario	Peak Load Reduction (kW)
NFI Current Technology w/DER	1278
NFI Advanced Technology w/DER	4151
Schneider Baseline w/DER	611

Smart charging and DERs can significantly lower coincident peak load.

To put into NJ Context: Currently 165,737 Heavy Duty Trucks Registered in NJ. If same coincident load savings apply it could mean between ~2.4 to 13.8 GW of avoided Coincident Peak load!

Smart Charging as Storage is Cost Competitive with Battery Storage



How Much Storage?

- V1G ~ 1 GW of storage
- V1G and V2G ~5 GW of storage.

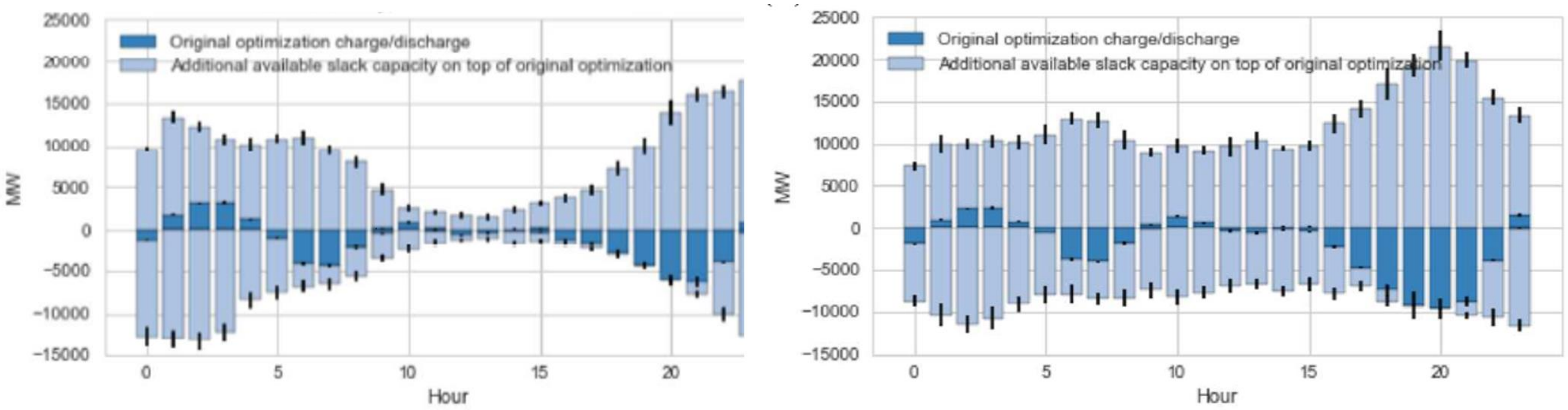
How Much Savings?

- V1G system-wide investment of ~$150 million, compared to $1.45-$1.75 billion for stationary (non-EV) storage would cost.
- V2G is worth $12.8 to $15.4 billion in equivalent stationary storage.

LBNL Study on LDVs shows without impacting driving needs V1G and V2G can provide storage….at a much lower cost.

Source: “Clean vehicles as an enabler for a clean electricity grid”, Jonathan Coignard et al 2018 Environ. Res. Lett. 13 054031, 16 May 2018

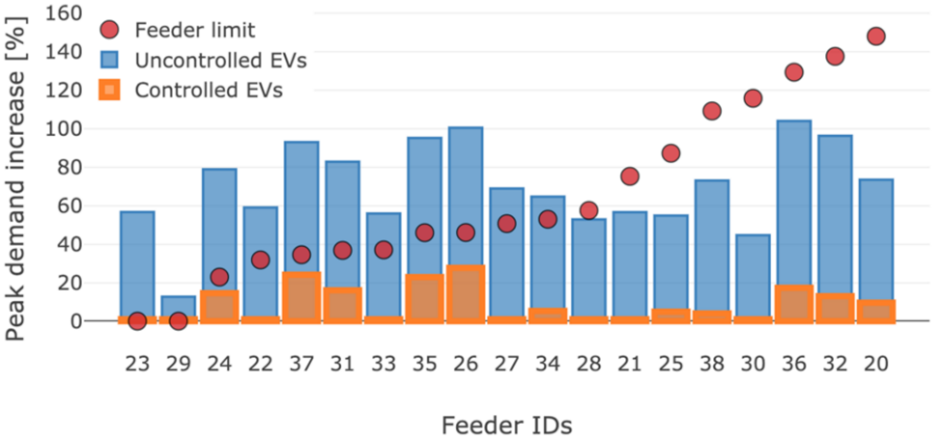
What is the Flexibility Potential of MHDVs?



Study by Midcontinent Independent System Operator showed expected EV charging can have 10 GW of upward and downward ramp capacity at any time of the day.

Source: Greenblatt, Jeff and Margaret McCall. “Exploring enhanced load flexibility from grid-connected electric vehicles on the Midcontinent Independent System Operator grid” Available here.

Don’t Underestimate V1G: It can Mitigate Build-out



Study evaluated impact on grid feeders at 100% passenger EV penetration.
Measurements: Voltage Stability and Available Capacity (Overloading).

Data:

- 50 feeders from PG&E
- Charging data from ChargePoint

EV and Grid models validated with real data.

Expanded Results to all 3000 PG&E Feeders

Main Results:

- If nothing is done, utilities will face large problems with voltage stability and overloading.
- If 28% of the EVs with respond through smart charging all issues can be avoided.
- Controlling EVs to charge at off-peak avoids most distribution grid issues.
- ***V1G is highly effective at mitigating distribution grid buildout.***

Source: Coignard, J., MacDougall, P., Stadtmueller, F. and Vrettos, E., 2019. Will electric vehicles drive distribution grid upgrades?: The case of California. *IEEE Electrification Magazine*

How do we get there? First get the Economics in Order

Utilities and other companies need clear opportunities to see returns on investments in DERs and Smart Charging:

- Utility Performance Incentive Mechanism would align utility business model with societal interests.
- Include storage and renewables in make ready programs
- Targeted Programs for Non-Wires Solutions
    - Get Creative with Rates
    - Bring Your Own Device Programs
    - Access to Wholesale Market Prices

Grid Planning, Accountability, and Transparency Drives Results

(1) To determine true avoided cost value of Smart Charging and DERs, Grid Impact studies which include state electrification targets should be done by utilities swiftly.

(2) Clear targets should be set for Smart Charging and Behind the Meter Renewable and Storage deployment.

(3) Utilities should be required to collect and monitor data to show the extent to which EVs are being effectively integrated into the grid, ensure prudent expenditure of ratepayer funds, and demonstrate achievement of pre-determined metrics and goals.

Targeted Marketing, Education, and Outreach is Necessary

Utilities, in collaboration with various local organizations and businesses, should develop targeted marketing, education, and outreach (ME&O) materials to help disseminate information to potential MHDV purchasers, recognizing that different communities and market segments will need nuanced approaches to how information is provided and presented.

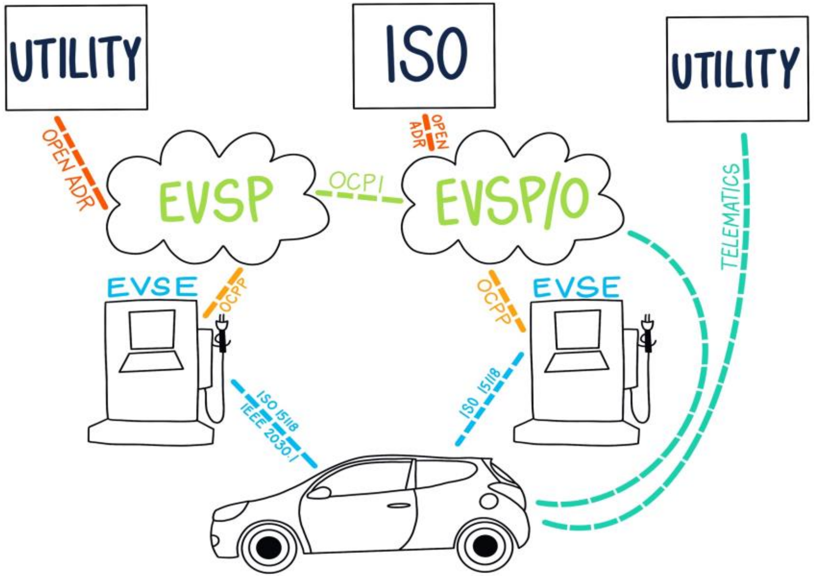
Communication and Data Standards are Key

Communication Standards:

- Open Charge Point Protocol (OCPP)
  - Avoid Stranded Assets
  - Customer Service Choice
- Demand Response (OpenADR)
- Get Price Signals to Customers
  - (OpenAdR & OCPP& ISO 15118)
- Roaming Billing (OCPI)

Data Standards:

- E.g. Utility Billing Data Formats

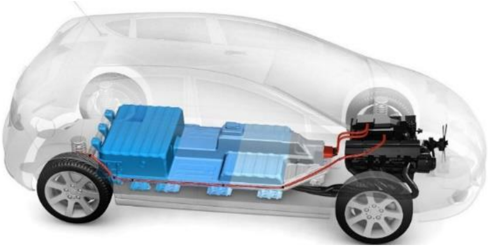


Source: Jessica Russo

Find Solutions for Expensive Metering And Telemetry

Solutions:

- Set metering requirements that match the service
- Define sub-metering requirements
- Allow 3rd party metering
  - e.g., CAISO Allows 3rd party metering for DERs wholesale participation



Pilot Programs:

Electric Vehicle sub-metering pilot

- e.g., Minnesota Xcel Energy

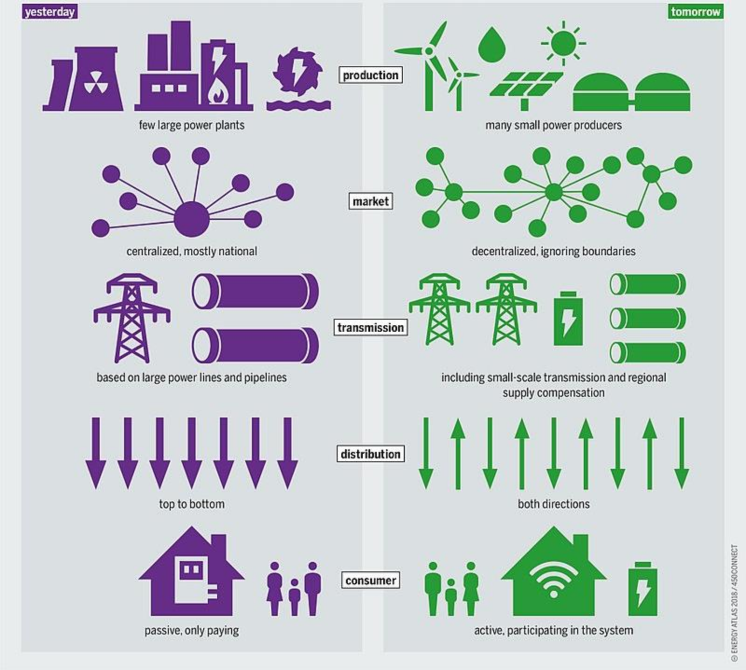
Get the Grid Ready: It's Time to Modernize

Enhanced Visibility
- Wide area monitoring and control
- Information Communication Technology Integration

Smart Technology
- Advanced Metering Infrastructure
- Grid automation

Advanced Billing Systems
- Subtractive billing

Holistic Interconnection Practices



Pamela MacDougall pmacdougall@edf.org

WYATT EARP
IBEW

New Jersey BPU

Medium & Heavy Duty Stakeholder Panel

Renewables, Storage, and Charging

September 21, 2021

CLEAN ENERGY WHEN DO WE WANT IT NOW

SOLAR GARAGES


Westbahnhof
203
202
201


CLEAN. SAFE. RELIABLE.
CLEAN. SAFE. RELIABLE.
SDGE
SDGE
SDGE
SDGE
Hybrid Electric
BUILDING AMERICA'S CLEANEST ENERGY COMPANY
SPEED LIMIT 5 MPH


PENSKE
7337-10-1
7337-10-11
PENSKE


FORD INTELLIGENT BACKUP POWER:
F-150 LIGHTNING
BUILT


THANK
YOU

Renewables, Storage, and Charging

NJ BPU MHD Technical Conference
September 21, 2021

Nekabari L. Goka
Manager, Strategic Initiatives – Utility of the Future
Pepco Holdings (parent co. of Atlantic City Electric)

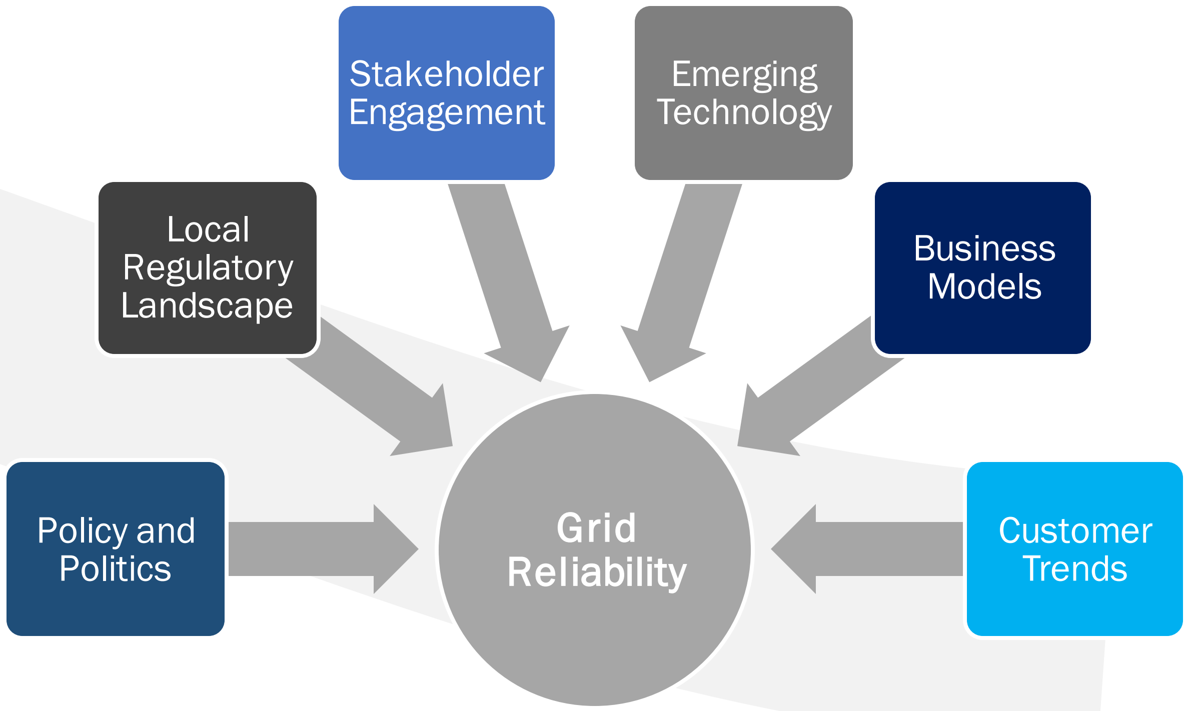
atlantic city electric

The Electric Slide – The role of utilities in transition

The **role of the utility is expanding** to support not only the achievement of its core function – the delivery of reliable service at affordable rates - but also **the facilitation of the achievement of broader policy objectives**

NJ EMP Strategic Objective

- Reducing **Energy Consumption and Emissions** from the Transportation Sector[1]
- Reducing **Energy Consumption and Emissions** from the Building Sector[2]
- Accelerate the deployment of **renewable energy and distributed energy resources**[3]



Drivers of Approach

1. 2019 NJ Energy Master Plan
2. Ibid
3. Ibid

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Location Matters – understanding capacity in a medium and heavy-duty world

The connections between utility programs and broader policy objectives becomes more profound as utilities assess the ways that **customer pursuits of policy objectives can influence grid planning**

Planning Considerations

- MHD vehicle adoption **can have significant impact the utility's approach** to its reliability maintenance strategy

- Early coordination between utilities and customers will be increasingly important
  - ❖ MDHD customer engagement tools
  - ❖ Technical Assessments as a Service

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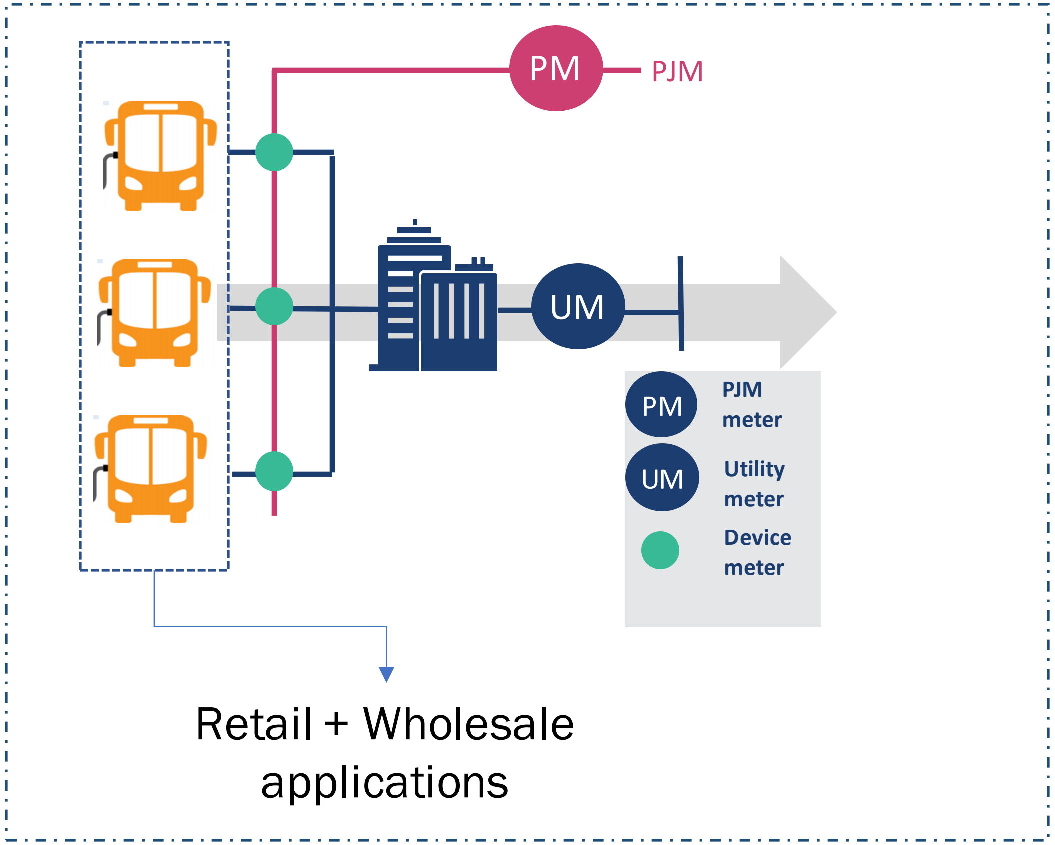
What is V2G...really?

Vehicle to Grid (V2G): a technology configuration that enables the **bi-directional flow of electricity** from the battery of an EV to the local power grid for purposes of contributing to the mitigation of the risk of uncertainty in the balance of the supply and demand of electricity



Technology Specific Considerations

- Wholesale vs retail boundaries
  - ➢ State of charge
  - ➢ Load vs Generation classification
- Grid services functioning as secondary (or tertiary) use case
- Focus on outcomes

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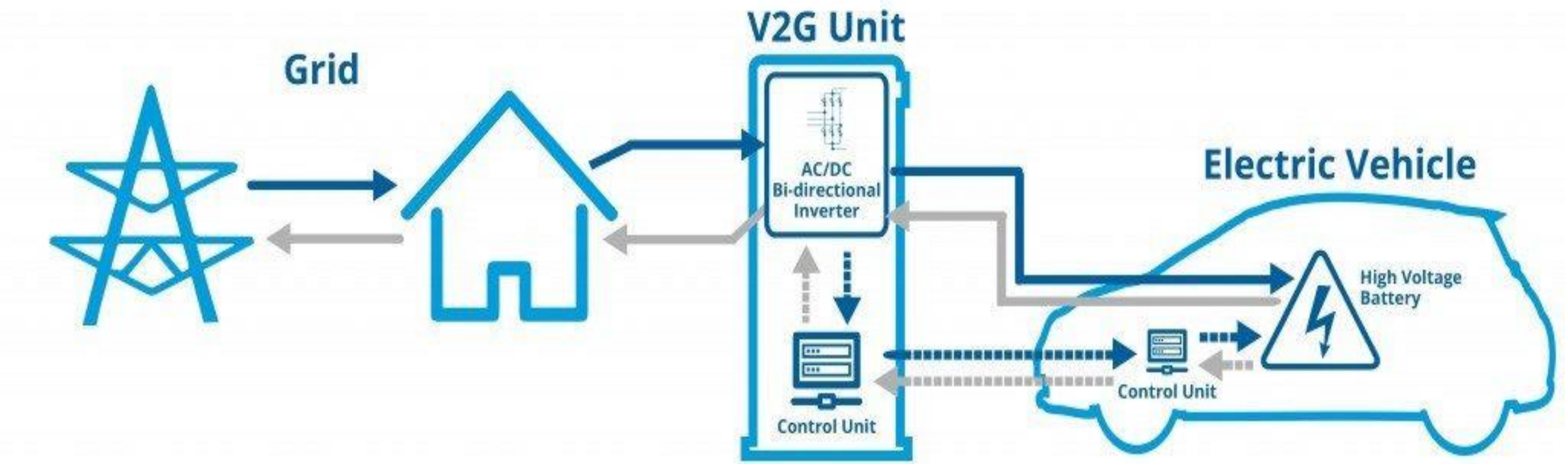
Is V2G ready for rate-payer investment?



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Thanks

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Medium and Heavy Duty Straw Proposal
Renewables, Storage and Charging

Clean Energy Ventures

Mark Valori
September 21, 2021

Benefits to ratepayers, utilities and state

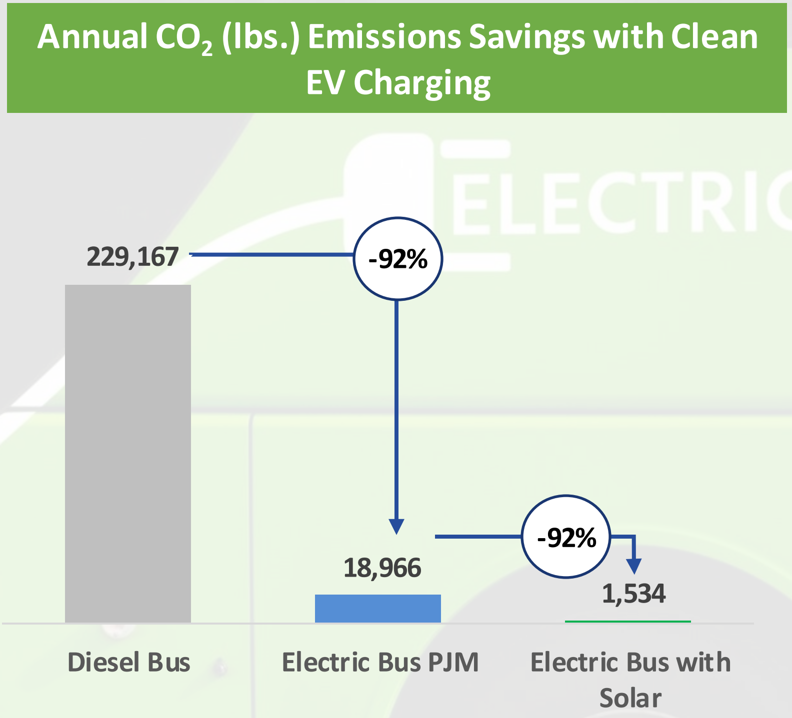
Ratepayer Customers

Utilities

New Jersey

Co-location of Electric Vehicle (EV) charging with solar, smart charging and storage "Clean EV Charging" benefits all stakeholders

- **Dampens system peak impact**
- **Solar EV charging supports state emission targets**
- **Lower integration costs**
- **Potential grid services**

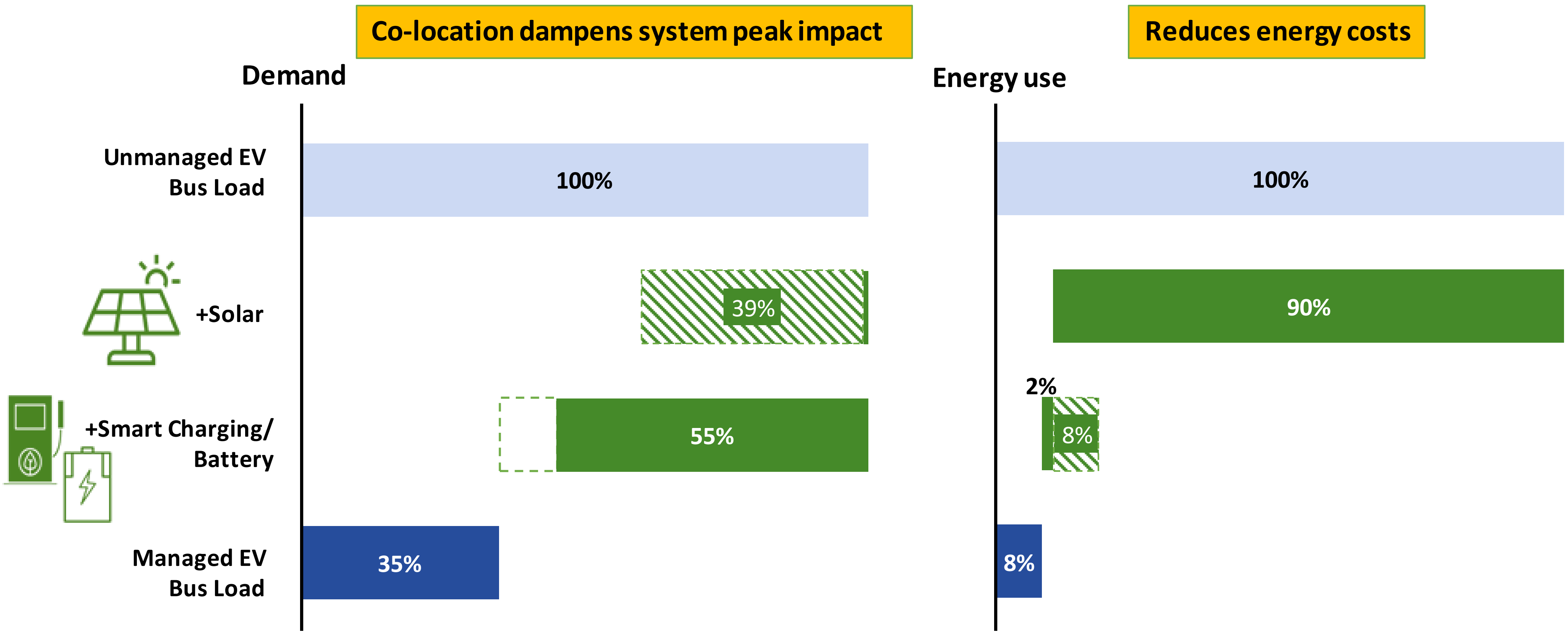


Source: DOE Alternate Fuels Data Center; Proterra

Co-location dampens peak impact and reduces energy costs

Illustrative: Clean EV School Bus Charging

Unmanaged EV Bus Load is Peaky, potentially **coincident with System Peak**



Co-location minimizes utility infrastructure investments and maximizes environmental benefits

Clean Energy Ventures

Source: NJRCEV Modeling

Clean EV Charging minimizes ratepayer impact

Clean EV Charging $ Impact

Annual Demand Retail Cost to Ratepayers ($M)

Co-location saves ~$16B 20 Year NPV* Value

Electrifying MHD represents ~1/3 of transportation emissions (~12.9 MMT)

Estimated +9GWs of unmanaged EV MHD demand

Assumptions	
	Demand Value ($/ kW year)
JCPL	$202.7
PSEG	$306.6
ACE	$186.2

Electric Demand (GWs)	**+9**	**-6**	**+3**

How do we achieve co-location of technology with EV charging?

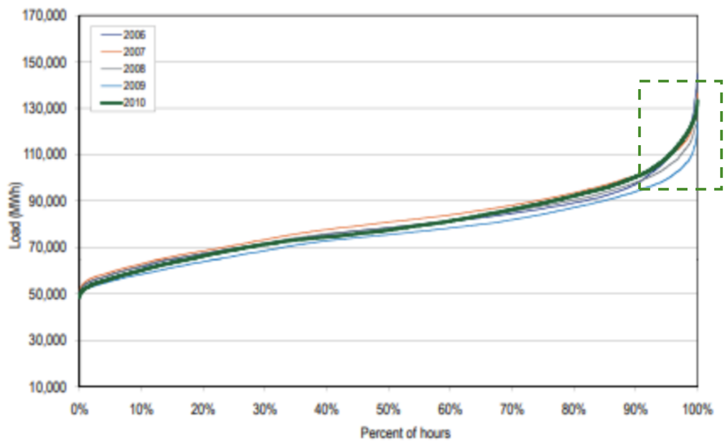
* At 7% discount rate, assuming $1.49B savings each year for 20 years

Source: Company new releases; PJM Forecast; NJDEP; NJ Administration; NJRCEV Analysis

Clean Energy Ventures

Coupling Time of Use (TOU) Rates and Renewables to Manage Demand

Focus on the "few hours" of peak load to minimize ratepayer costs



< 5% to 10% of hours account for system peak

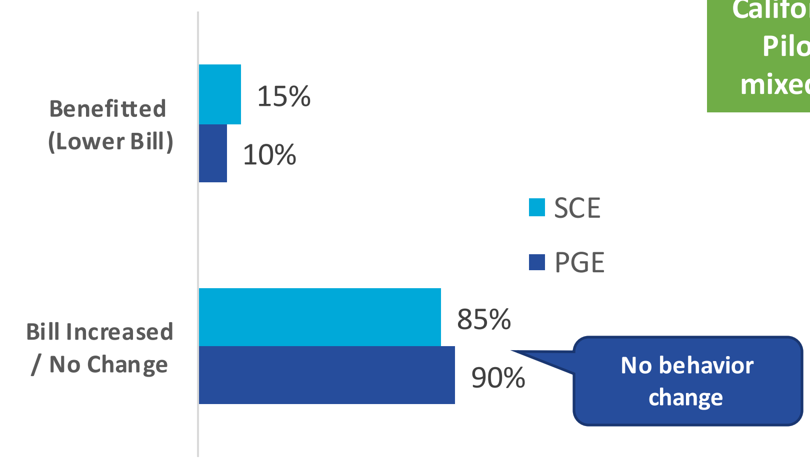
California EV time of use tariffs, with Peak to Off-Peak Price Ratios of ~3X and shorter time durations

$/ kWh

Hour

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SCE	$0.17															$0.44							$0.17	
PG&E	$0.17															$0.49						$0.38		
SDG&E	$0.22						$0.37									$0.62							$0.37	

TOU rates alone not sufficient…



California TOU Pilot with mixed results

NJR Perspectives:

- **Replace demand charges (Distribution and BGS) with highly differentiated TOU rates**
- **Co-locate and incentivize smart charging and renewables**

Clean Energy Ventures

Source: California PUC; RMI

Straw Proposal Questions

Staff Question

- How should renewables and storage be incentivized and do they need to be incentivized?

NJRCEV Perspective

● High
○ Low

Enabling Policy	Minimize Ratepayer Impact	Encourages Renewables	Supports state EV goals	Encourages emerging technologies
Replace demand charges and introduce "Highly differentiated" TOU rates	●	●	◕	○
Encourage co-location at sites >500 kW to minimize utility infrastructure investments	●	●	●	○
• Incentivize solar canopies bundled with charging stations (e.g., Parking lots)	●	●	◕	○
• Encourage EV charging at existing solar sites (e.g., Clean Energy Depots)	●	●	◕	○
Incentives for storage to bridge near term gaps	◕	●	◕	○
Encourage pilots of V2G and Green Hydrogen	◑	◕	◔	●

Source: NJRCEV Analysis

NJRCEV TEAM

Mark Valori
Vice President

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Thanks!

FREEWIRE

ELECTRIFICATION BEYOND THE GRID

New Jersey BPU

Medium and Heavy Duty EV Charging Ecosystem

Renewables, Storage, and Charging

September 21, 2021

FreeWire Technologies at a Glance

Company Overview

Founded in 2014 in the San Francisco Bay Area

Developed industry-leading technology to solve the pain points around scalable ultrafast EV charging – mitigating the cost and complexity of heavy grid infrastructure.

FreeWire offers flexible solutions to C&I customers using battery storage, charging technology, and energy management software.

FreeWire creates a distributed network of ultrafast chargers that use existing low-power infrastructure in intelligent & cost-effective ways.

Focused on deploying ultrafast charging infrastructure and energy optimization services to four target verticals – retail, utility, network operators, and fleets.

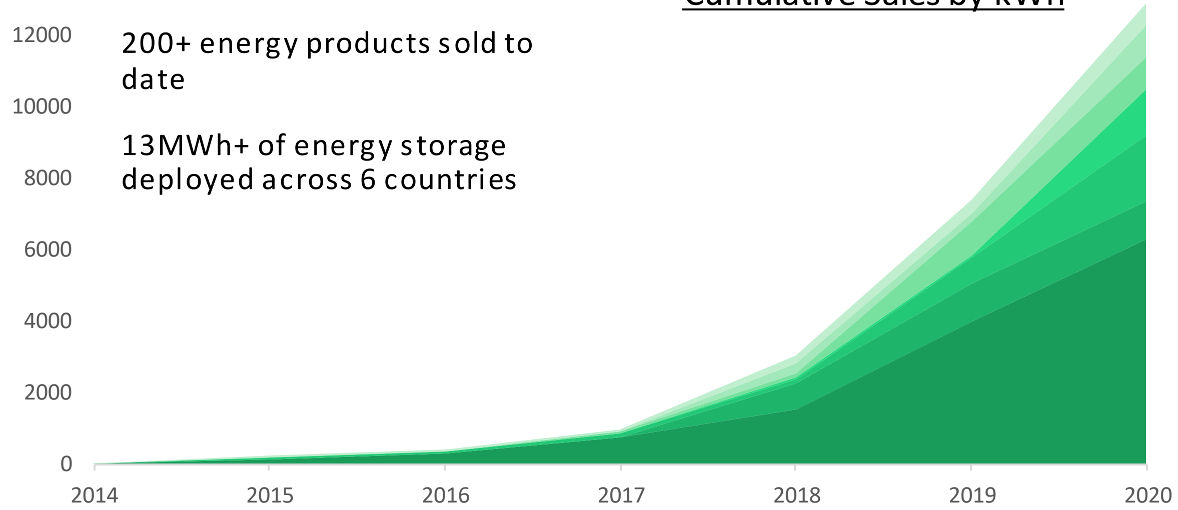
Company KPIs

50+ Fortune 500 customers

200+ energy products sold to date

13MWh+ of energy storage deployed across 6 countries

Cumulative Sales by kWh



Strategic Partners & Customers

Previous Funding Rounds

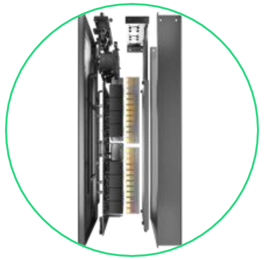
2017
Seed

2018
Series A

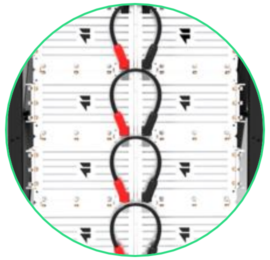
2020
Series B

2021
Series C

FreeWire’s battery-integrated Boost Charger



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



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

Envision AESC

150 kW fast charging

150 kW to charge 1 EV, OR 75 kW to charge 2 EVs simultaneously
Connectors compatible with all EVs

160 kWh

Lithium-ion energy storage boosts power from the grid to EVs

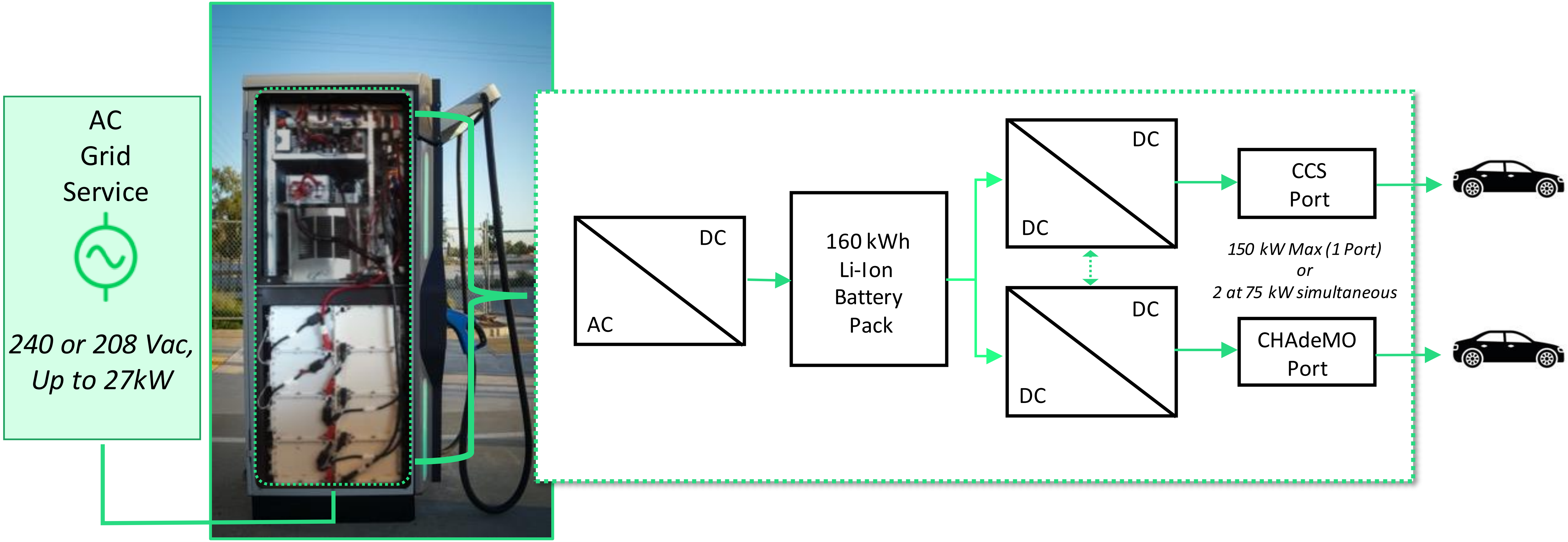
Low-voltage grid

Connects at widely-available 208V or 240V, same as Level 2
Avoids utility and customer-side electrical infrastructure

ADVANCED CONTROL SYSTEM
Optimized to enable distributed energy services

How it Works

Low voltage AC power input → AC power converted to DC → Integrated battery discharges → 2 high-efficiency DC converters → Dual connectors for simultaneous fast charging



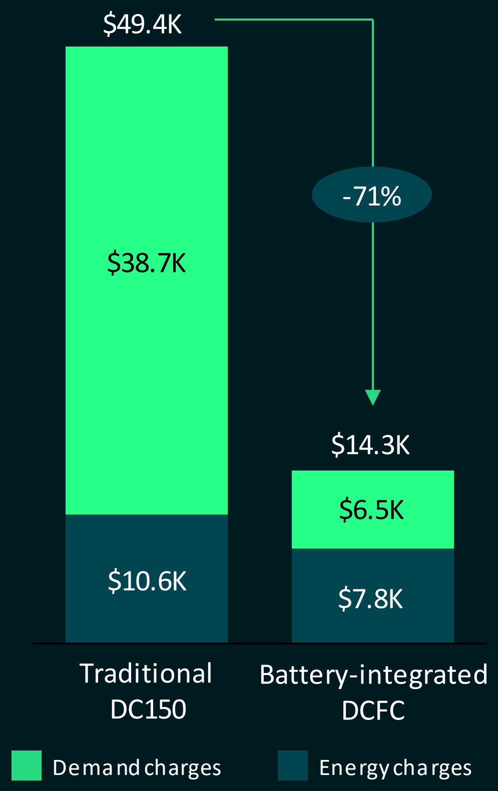
Boost Charger

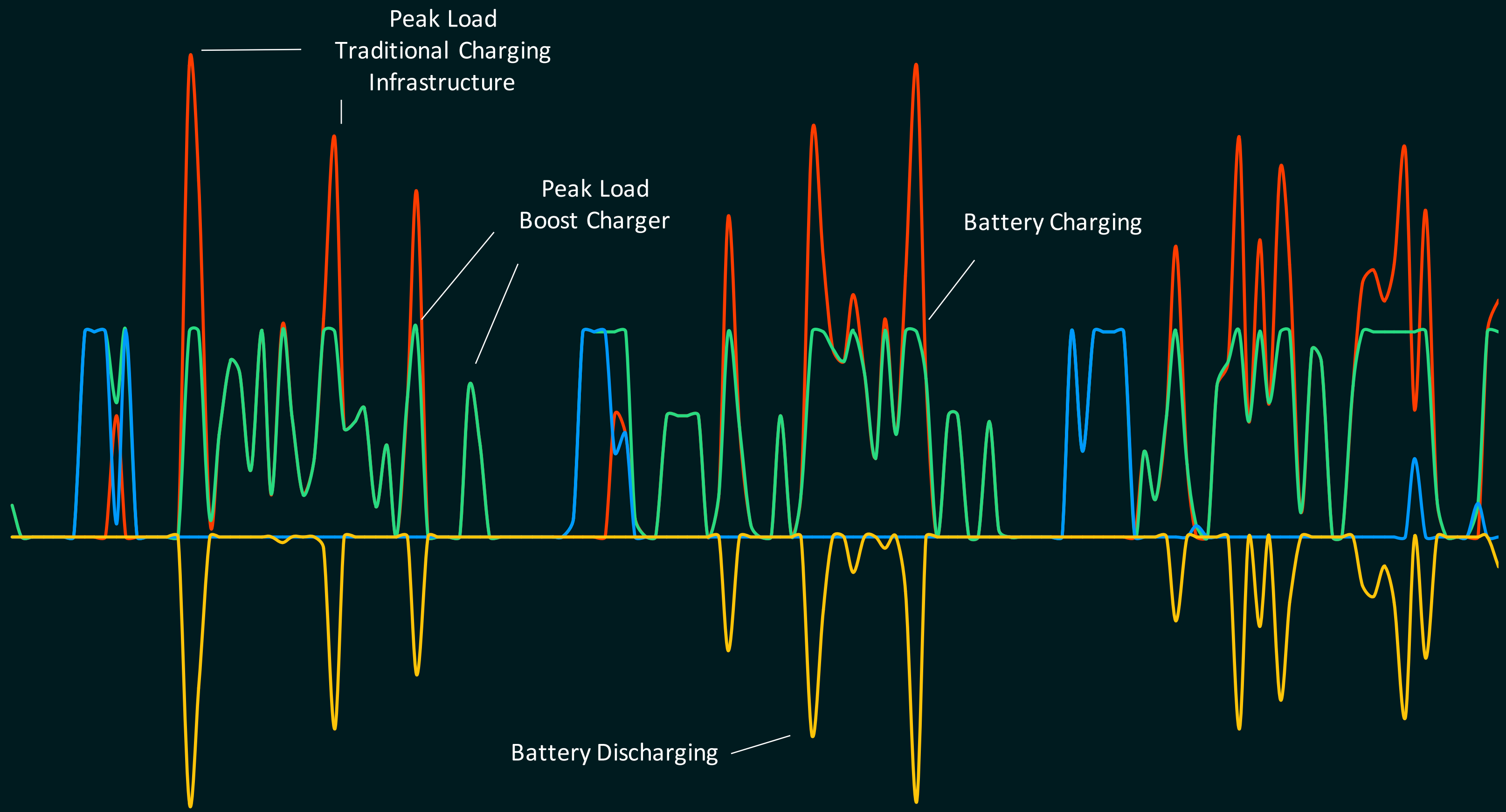
Pairing with energy storage to manage energy costs

Reducing Total Operating Expenses

70%
Lower operating costs

$35K
Savings per year





Source: PG&E demand charge schedule and PG&E tiered energy usage charge structure; McKinsey EVCI demand model.

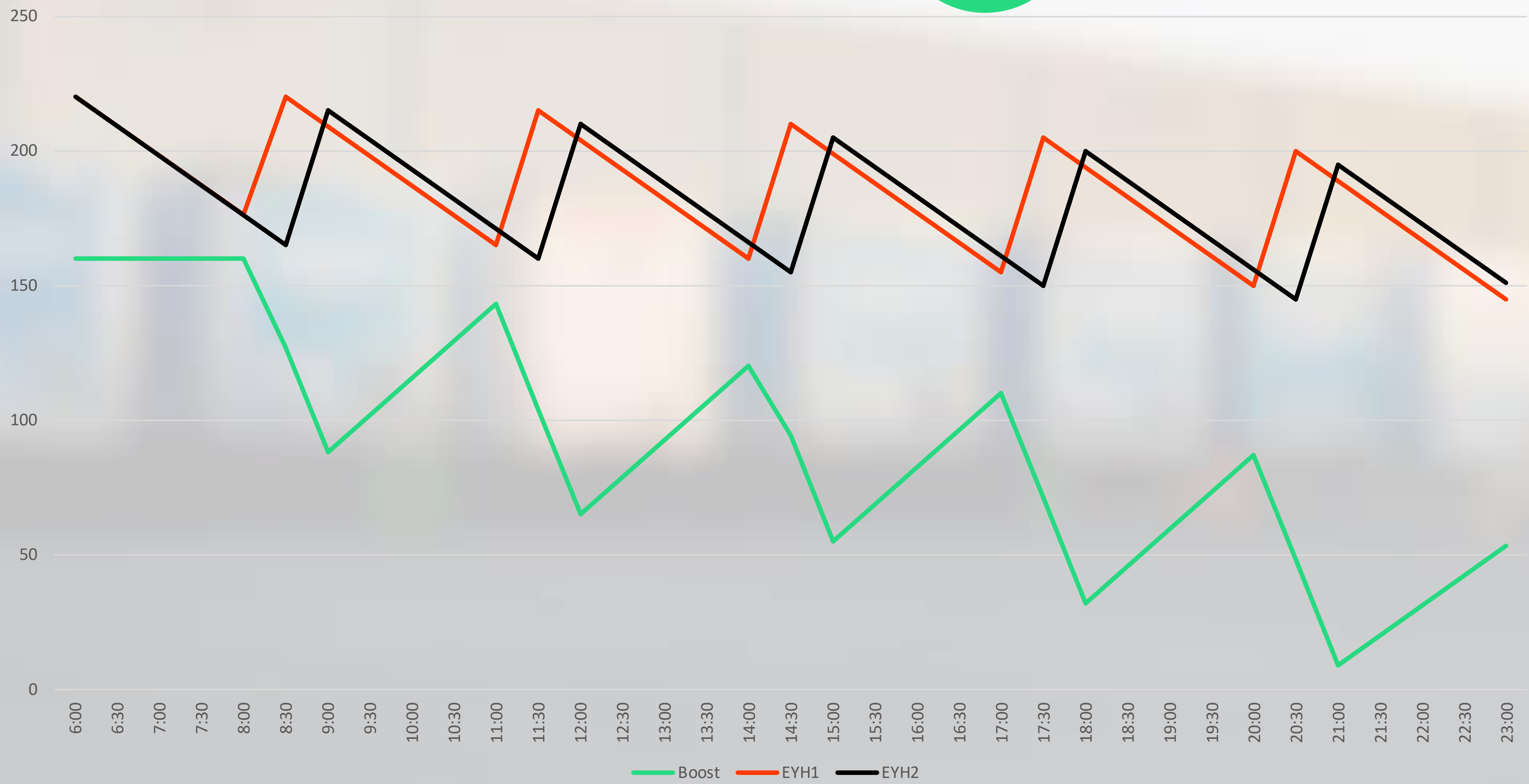
2 EYH Yard Charging Profile

10

Charging Sessions Per Day
System is designed to support 15-25 charging sessions per day under most operating assumptions.

2X
EYH SOC
(kWh)

Boost Charger
SOC (kWh)



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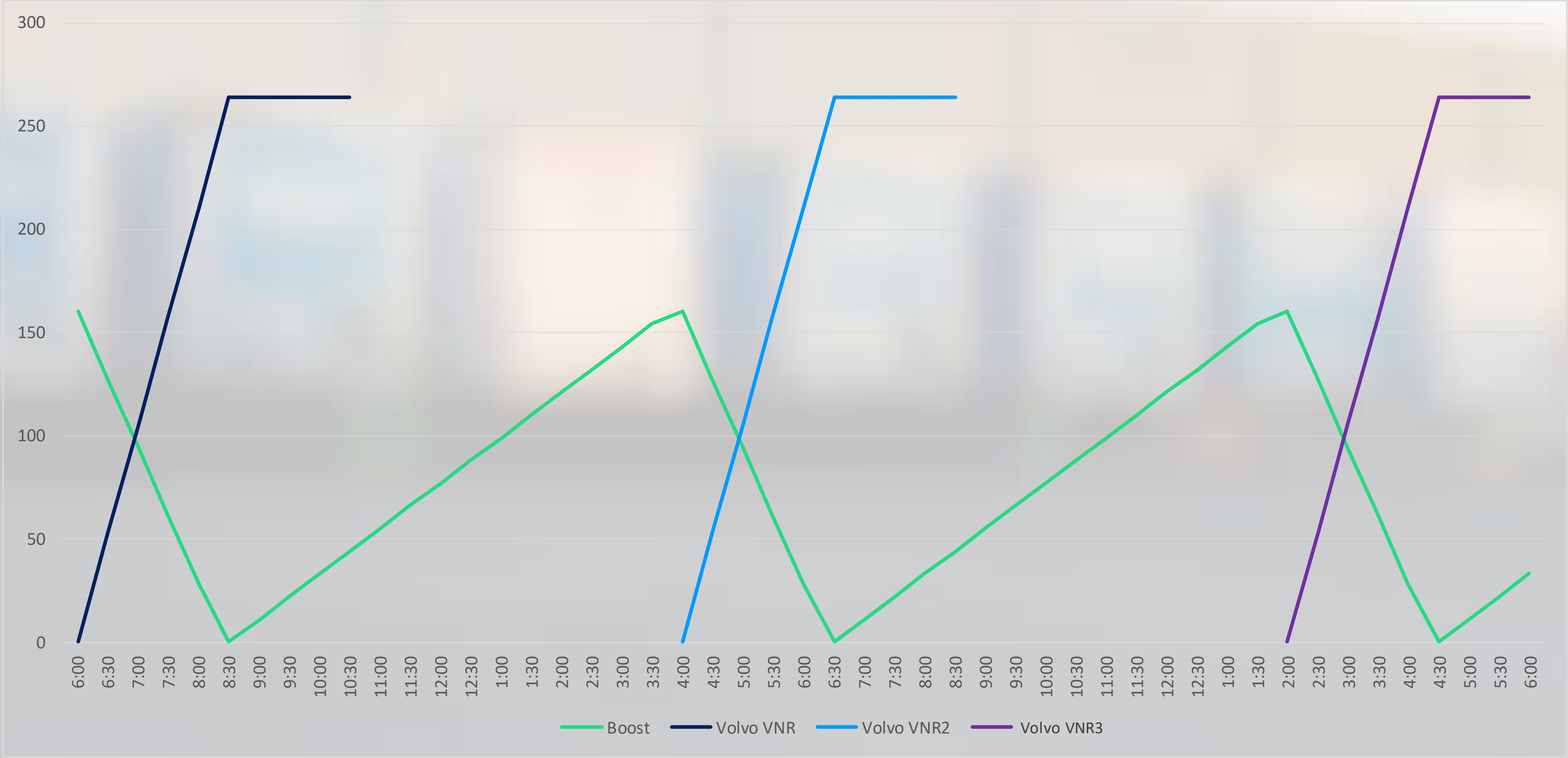
3 Volvo VNR

3 hour 264kWh Charging Sessions Per Day

Boost Charger SOC (kWh)

VNR SOC (kWh)



Considerations for MHDV Straw Proposal

- Incentivize energy storage configurations as make-ready alternative
  - Useful alternative where wires solutions are cost prohibitive or impractical
  - Useful alternative where MHDV companies/managers do not own their property
- Encourage the use of energy storage to manage energy costs (e.g., demand charges) and mitigate strain on the grid
  - Incentivize energy storage to be on par with rate design solutions
  - Position energy storage for peak load reduction, load shifting, and time-of-use rates
  - Position energy storage for grid-down charging, integration of renewables, source of on-site power needs
- Establish dedicating funding and award rebates on per kWh basis
- Address any interconnection challenges early to ensure successful implementation

FREEWIRE

ELECTRIFICATION BEYOND THE GRID

Peter Olmsted

Director of Regulatory Affairs

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Topics:

1. **Scale:** How much total energy storage will New Jersey EV's have? How much in Medium/Heavy Duty EV's?

2. What is the tie-in between **Renewables** and heavy-duty electric vehicles? How important is it?

3. Heavy-duty EVs and **Resiliency**

4. What is needed in order for EV's to play a role in the Renewable Energy transition? **What are the challenges?**

5. How do we **pay for the infrastructure** for EV's? **Can we?**

1. Scale: How much total energy storage will New Jersey EV's have? How much in Medium/Heavy Duty EV's?

Examples of MHD EV Battery Sizes

BYD Class 8 Truck:
400 KWH

BYD Class 6 Truck:
175 KWH

BYD Bus:
348 KWH

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MSSIA EV Storage Capacity Mini-Study – 2018
(updated for Electric Vehicle Law)

Statewide Total of EV Battery Capacity in:

2025 (EV Law):

330,000 total EVs (~5%)	~27,000 MWH
- Medium/Heavy Duty Only	~3,000 MWH

2035 (EV Law):

2,000,000 total EVs (~30%)	~160,000 MWH
- Medium/Heavy Duty Only	~17,000 MWH

For Comparison….

Clean Energy Act battery requirement for 2030:	2,000 MW
	= ~6,000 MWH

2. What is the tie-in between Renewables and heavy-duty electric vehicles? How important is it?

- EVs are batteries on wheels. Most vehicles are traveling only 4% of the time. When not traveling they can (and should) be plugged in.
- When plugged in, EV batteries can be used partially to stabilize frequency or voltage (by modulating or curtailing their charging).
- EV batteries could be used fully if 2-way power flow is enabled. They could play a major role, or perhaps even a dominant role, in enabling high penetration of the grid with intermittent renewables (solar and wind). This is called vehicle-to-grid, or V2G.
- By 2035, even a small percentage of EVs, plugged in and capable of 2-way power flow, could keep pace with the need for storage to stabilize the grid with solar+wind per the Energy Master Plan.

2. What is the tie-in between Renewables and heavy-duty electric vehicles? How important is it?

- **Medium/Heavy Duty EVs are not a large percentage of the total potential battery storage capacity in EVs, but they are ideally suited because of their large individual energy capacity and power capacity.**
- **Medium/Heavy Duty EVs may also be easier to recruit for V2G service, especially if they are associated with local or state government entities, or critical facilities.**

3. Heavy-duty EVs and Resiliency

- **When EVs are plugged with 2-way power flow enabled, they could potentially function as part of a microgrid system to help keep critical facilities operating.**
- **Imagine a large hospital with EV ambulances, and over 5,000 employees, many of them plugged in to a hospital microgrid. Or a town Department of Public Works with many EV garbage trucks and other heavy-duty vehicles. Or a school with dozens of EV buses plugged in.**
- **Municipal and state medium/heavy duty EVs could also provide <u>mobile sources of power</u> during widespread power emergencies, periodically returning to replenish their power at a municipal renewable or renewable hybrid microgrid.**

1. Heavy-duty EVs and Resiliency

For Comparison…..

Hopewell High School
Solar + Storage Microgrid
~ 550 KWH

Resilient power for warming shelter + kitchen

One BYD Bus:
348 KWH

4. What is needed in order for EV's to play a role in the Renewable Energy transition? What are the challenges?

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4. What is needed in order for EV's to play a role in the Renewable Energy transition? What are the challenges?

- When charging stations want to utilize EVs to stabilize the grid with two-way power flow, the vehicles are in charge (no pun intended). Thorough cooperation is needed from the vehicle manufacturer.
- Cooperation and permission will also be needed from the vehicle owner.
- Grid infrastructure improvements for charging and for distributed renewables are related, and in fact often may coincide. Thus, they need not be additive.
- Full V2G requires communication and control infrastructure. This implies a strong utility role, especially with regard to the distribution system (and to some extent the transmission system, too).
- When do we start? If V2G is judged to be essential for the grid of the future, how much can we afford to spend on infrastructure that doesn't have that capability?

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5. How do we pay for the infrastructure for EV's? Can we?

- **As noted previously, utilities have a natural, and likely necessary, role in building distribution system grid infrastructure, 2-way charging infrastructure, and communication/control for EVs. This role is already anticipated in the BPU staff straw proposal.**

- **The straw proposal anticipates asking utility companies provide the grid infrastructure to bring power to EV charging stations. Utilities will then recover the cost of those infrastructure improvements through the rate base.**

Note: Solar industry plug -
We are deciding to require utilities to install the grid infrastructure to charge EVs, (and probably control and utilize them), and recover the infrastructure cost through the rate base. We have not yet made that decision for distributed renewable energy. That makes us solar folks feel puzzled.

Can we afford a clean energy & clean transportation future?

DOE Solar Futures Study, September 8, 2021:
"A renewable-based grid will create significant health and cost savings – Reduced carbon emissions and improved air quality result in **savings of $1.1 trillion to $1.7 trillion**, far outweighing the additional costs incurred from transitioning to clean energy. The projected price of electricity for consumers does not rise by 2035, because the costs are fully offset by savings from technological improvements."

MSSIA Mini-study, 2021: "Costs, Benefits, and Rate Impacts of Green Energy Programs – 2021 to 2050" Considered the effect of all green energy and EV programs on electric bills, including electric market and other benefits: With depression of wholesale costs from renewable sources & bill reductions due to energy efficiency, **bills will be reduced by $1.19 per month each year ($34.57 by 2050).** Transportation cost savings, and savings in the social cost of carbon, and savings in the cost of local pollution **provide an additional $6.12 per month savings in 2021, rising to $161.21 per month by 2050**. Jobs & economic growth and other benefits would provide additional value.

Can we afford a clean energy & clean transportation future?

MSSIA Mini-study on the affordability of electric power in NJ relative to other states:

Rates: **New Jersey ranks 10th** out of the 50 states and D.C. All the other states in the Northeast have higher rates than Jersey, except Maine, which is very slightly lower than Jersey.

Bills: (Per Capita Expenditures on Electricity)**: New Jersey ranks 30th** due to its low average usage. Being more *efficient at using* energy helps keep bills low in states like New Jersey and California.

Affordability: (Percent of Personal Income Spent on Electricity)**: New Jersey ranks 45th.** The national average percent of personal income spent on electricity is 0.79%. New Jersey's percent of income spent on electricity is 0.61%, placing it near the bottom of all US states and D.C.