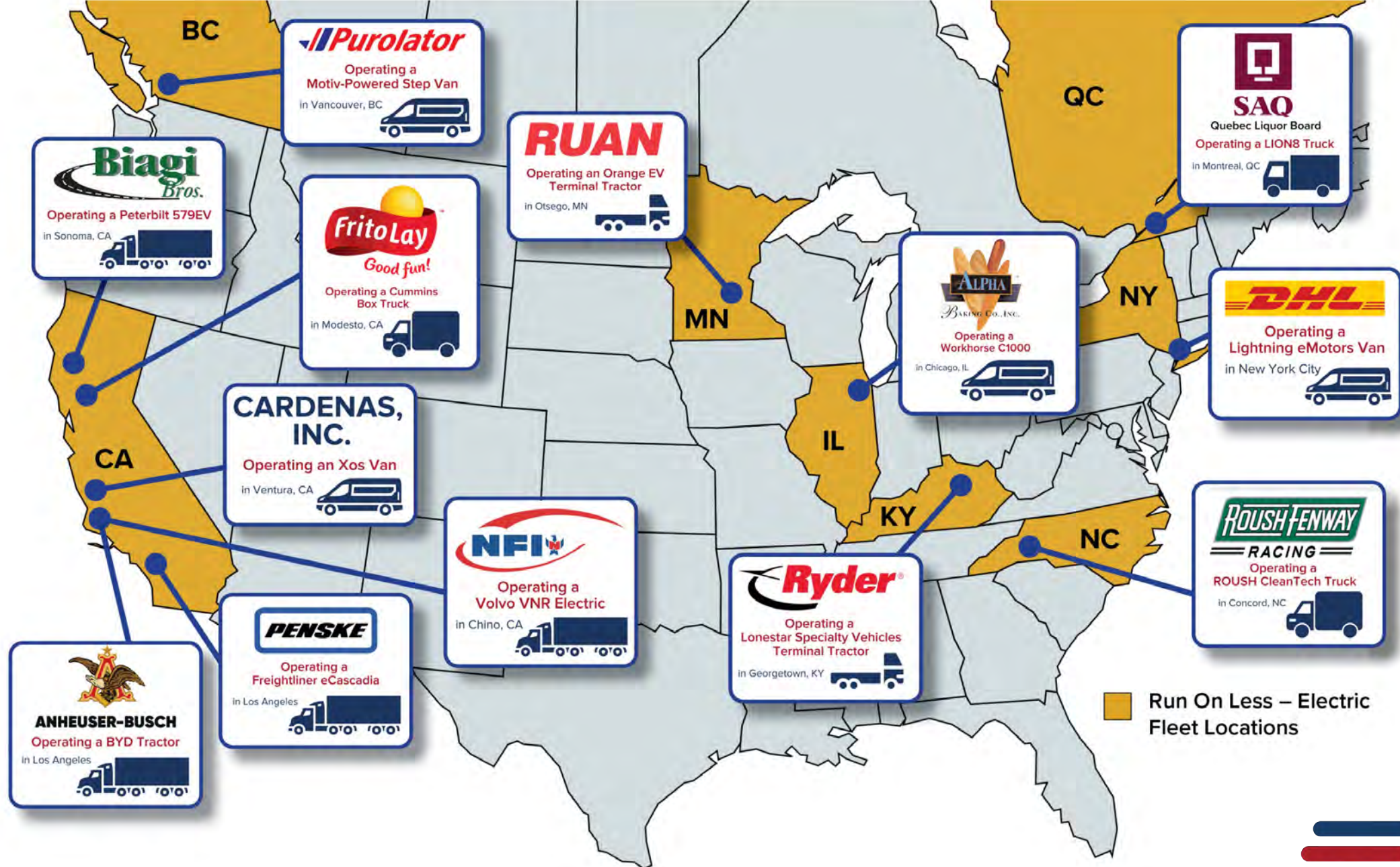


Charging 201: Power Management & Resilience

May 18, 2021





More info at www.runonless.com

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ON LESS**
ELECTRIC



Join us for the 10th anniversary of the leading clean transportation event!

August 30 to September 2, 2021

Bootcamp Attendees Discount Code: **BOOTCAMP50**

Register at www.actexpo.com/register

Last Training



Earlier this month we covered
Charging 101: Planning & Buildout

Video recording now available at:
www.RunOnLess.com



Coming Up

Our next training is **June 1** on
Working with Your Utility



To test your knowledge and earn
your Electric Truck Expert badge,
please visit: www.RunOnLess.com



Today



Charging 201: Power Management & Resilience



Thank you to today's sponsor!



Before we get started:

Q&A

Submit your questions to the host using the Q&A box in the upper right-hand corner.

Survey

There will be a 30-second survey shown at the end. We appreciate your feedback!

Presentations

A recording of today's webinar will be available on the ACT News website, and you will be emailed a link by early next week.

Technical Issues

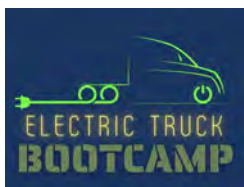
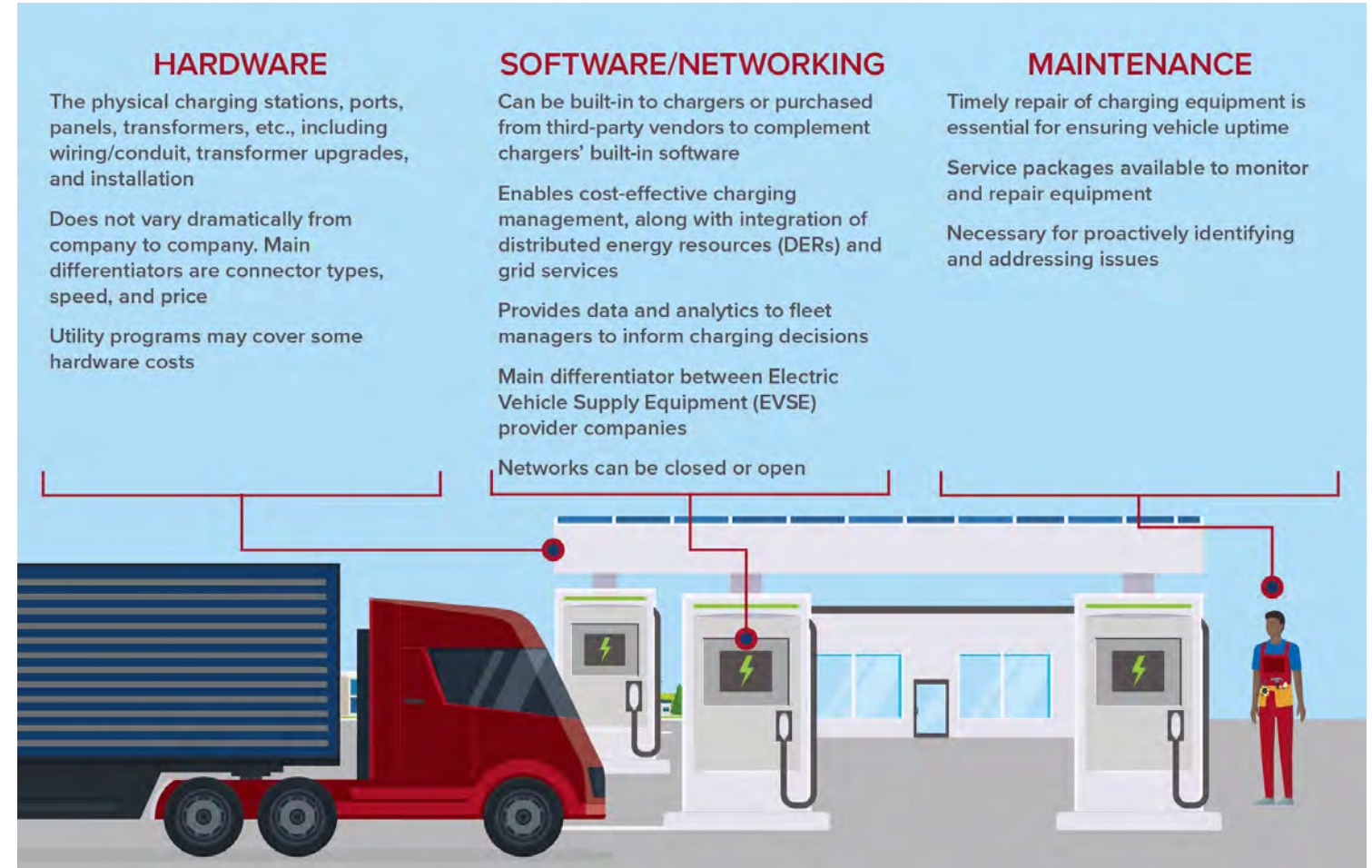
Contact Benjamin Chan at:
benjamin.chan@gladstein.org
or call 310-573-8545 for assistance.



Charging is about more than hardware

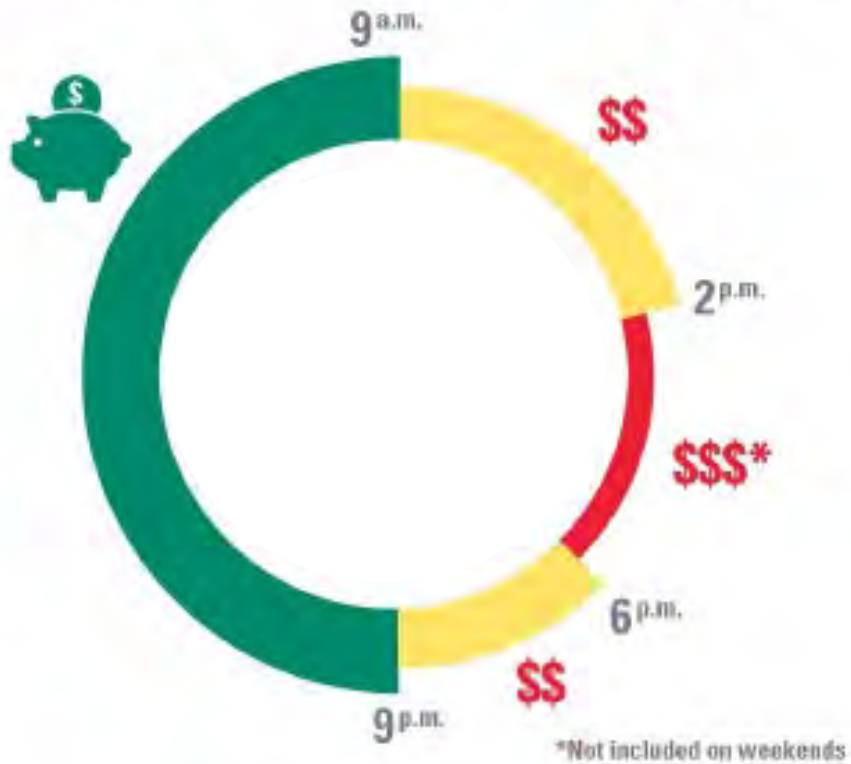


Source: NACFE

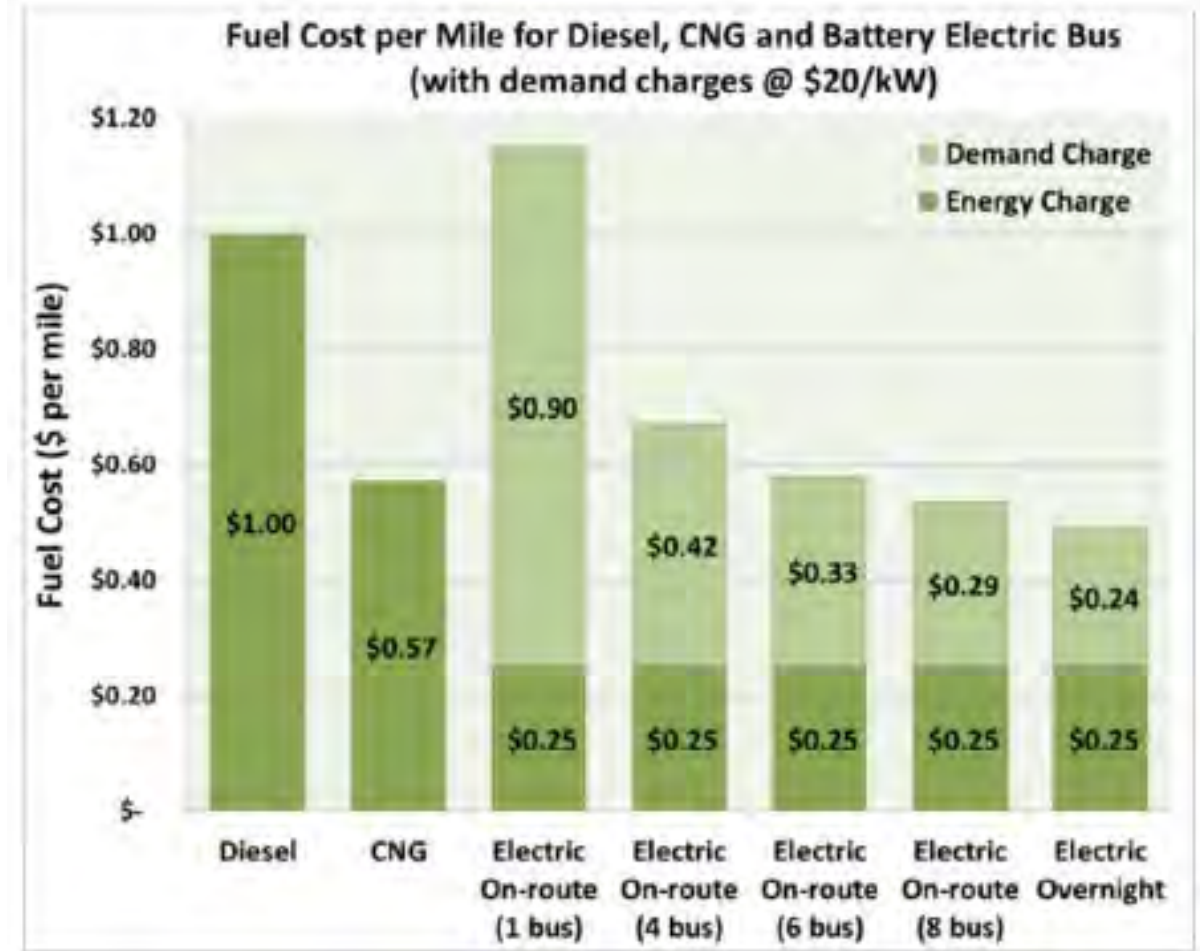


Managed Charging

Time of Use Pricing



Source: Xcel Energy



Source: CALSTART

Resilience

ASSESSING THE IMPACT OF WILDFIRES ON THE CALIFORNIA ELECTRICITY GRID

A Report for:

California's Fourth Climate Change Assessment

Prepared By:

Larry Dale, Michael Carnall, and Max Wei¹, Gary Fitts², Sarah Lewis McDonald³

¹Lawrence Berkeley National Laboratory

²Greenware Technologies

³Envision Geo

DISCLAIMER

This report was prepared as the result of work sponsored by the California Energy Commission. It does not necessarily represent the views of the Energy Commission, its employees, or the State of California. The Energy Commission, the State of California, its employees, contractors, and subcontractors make no warrant, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the California Energy Commission; nor has the California Energy Commission passed upon the accuracy or adequacy of the information in this report.



Edmund G. Brown, Jr., Governor

August 2018
CCCA4-CEC-2018-002

Texas House targets power grid flaw that cut electricity to natural gas facilities and worsened February blackouts

The lower chamber gave initial approval Monday to a series of bills responding to this year's catastrophic power outages during a deadly winter storm.

BY SAMI SPARBER APRIL 19, 2021 3 PM CENTRAL



COPY LINK

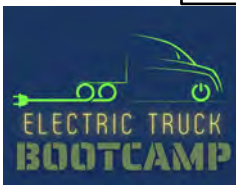
REPUBLIC



A mobile home park is covered with snow as a massive winter storm engulfed Texas, causing widespread power and water outages across the state in February. The Texas Legislature is considering several bills aimed at preventing power outages in the future. Jordan Vonderhaar for The Texas Tribune

Source: California Energy Commission

Source: Texas Tribune



Today's Speakers:



Levi Lomeland

*Sr. Account Executive in charge
of West Coast Business
Development
Electriphi*



Scott Fisher

*Vice President of Fleets & OEMs
Greenlots*



Namit Singh, Ph.D.

*Chief Strategy Officer &
CoFounder
Microgrid Labs*



Pam MacDougall

*Senior Manager of Grid
Modernization
Environmental Defense Fund
(EDF)*



Christy Lewis

*Director of Analysis
WattTime*



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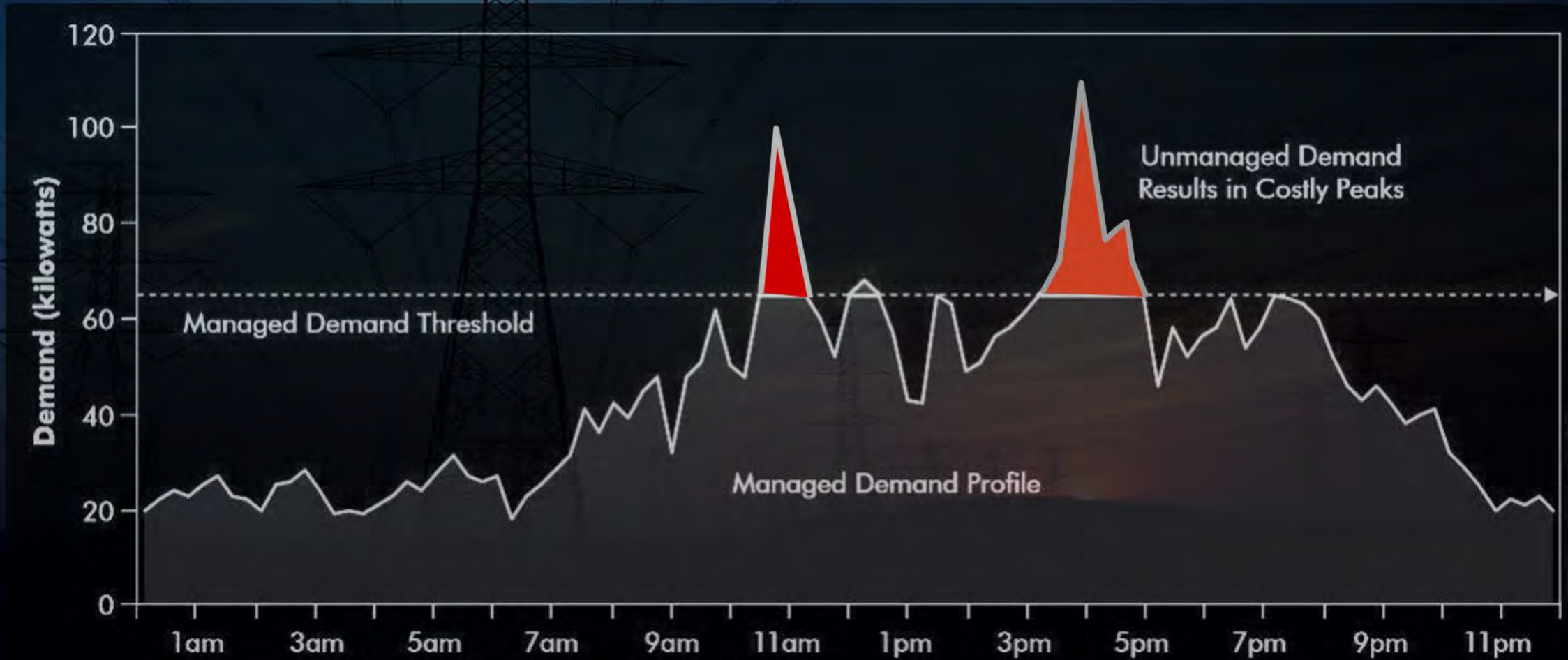
NACFE Electric Truck Bootcamp 2021

Charging 201: Power Management and Resilience

Levi Lomeland



Problem: Variable energy costs



Problem: Infrastructure costs

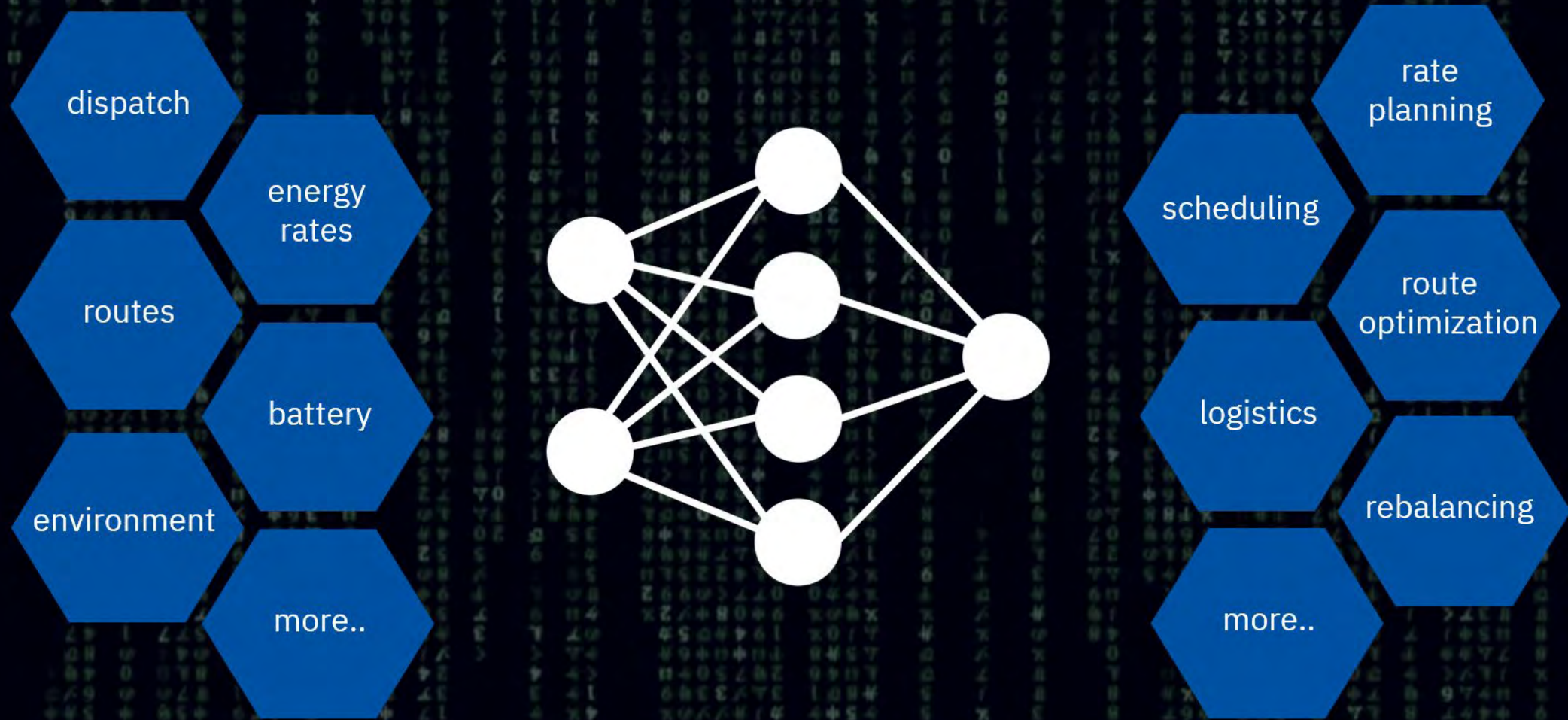


High peak load
requirements



Infrastructure
costs and delays

Problem: Operational Complexity



Solution: Intelligent Fleet and Energy Management

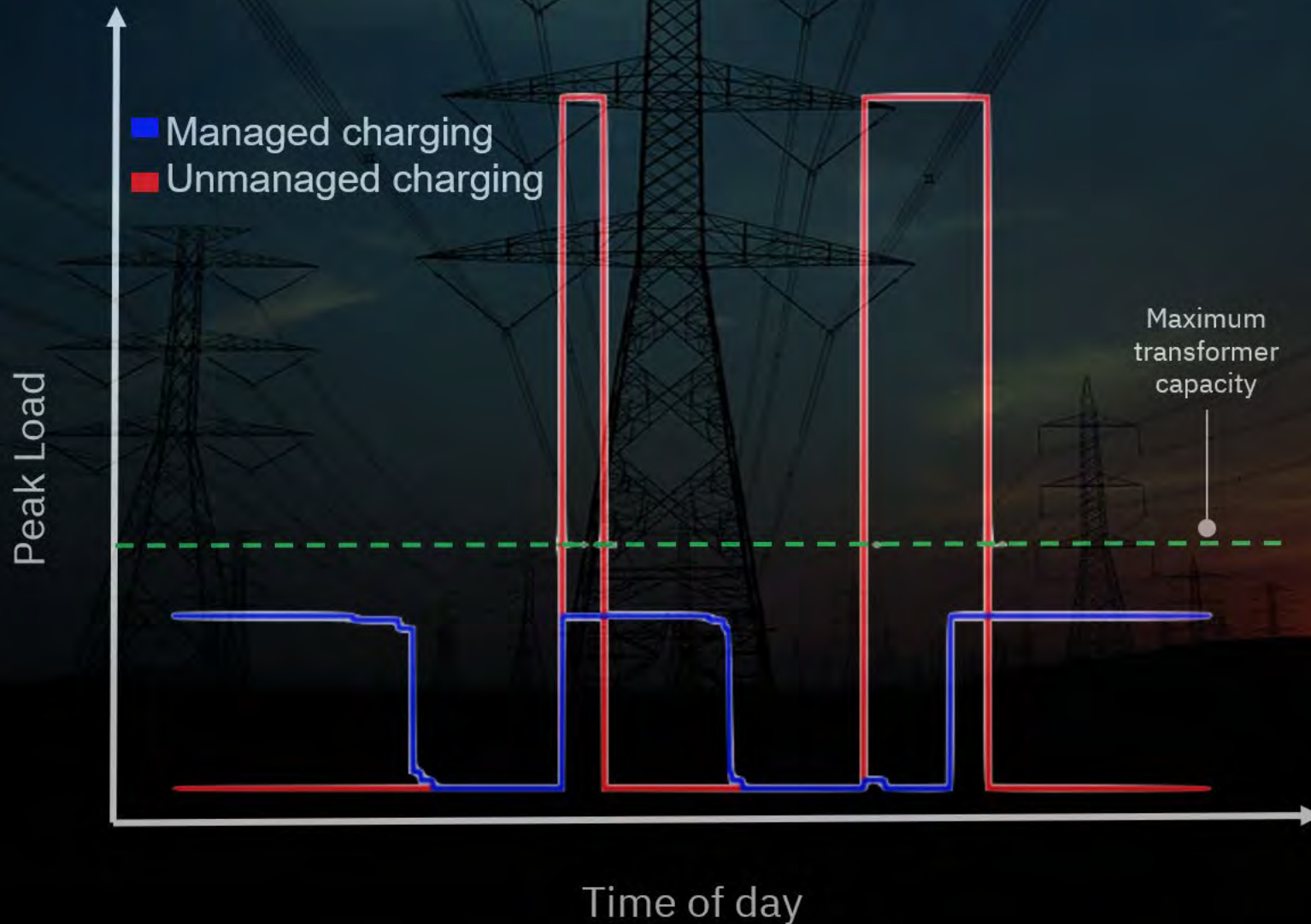


Fleet
operations



Charging
management

Managed charging benefits



Reduce
energy costs



Avoid
transformer
upgrades



electriphi

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*Director of Analysis
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5/17/2021

Charging 201 – Power Management & Resilience

Redefining Fleet Electrification with Greenlots



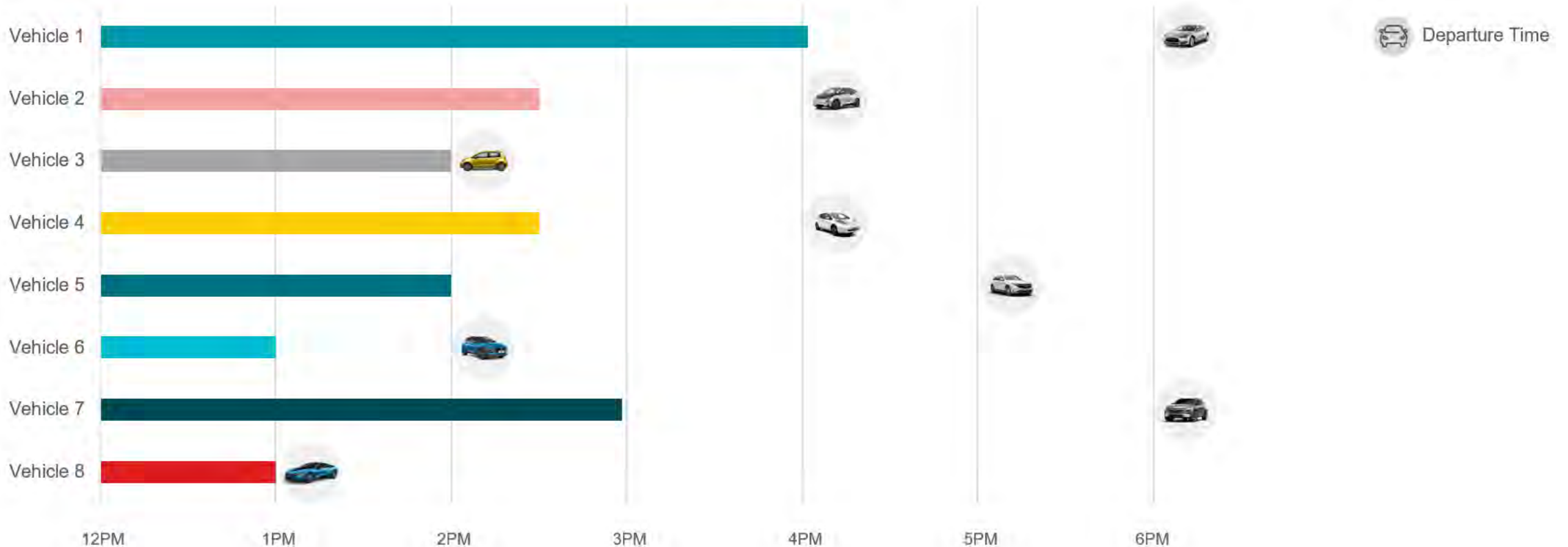
greenlots
A Member of the Shell Group

Confidential

Non-optimized Fleet Charging

Vehicles start charging as soon as they are connected. Extended periods where vehicles are connected but are not charging

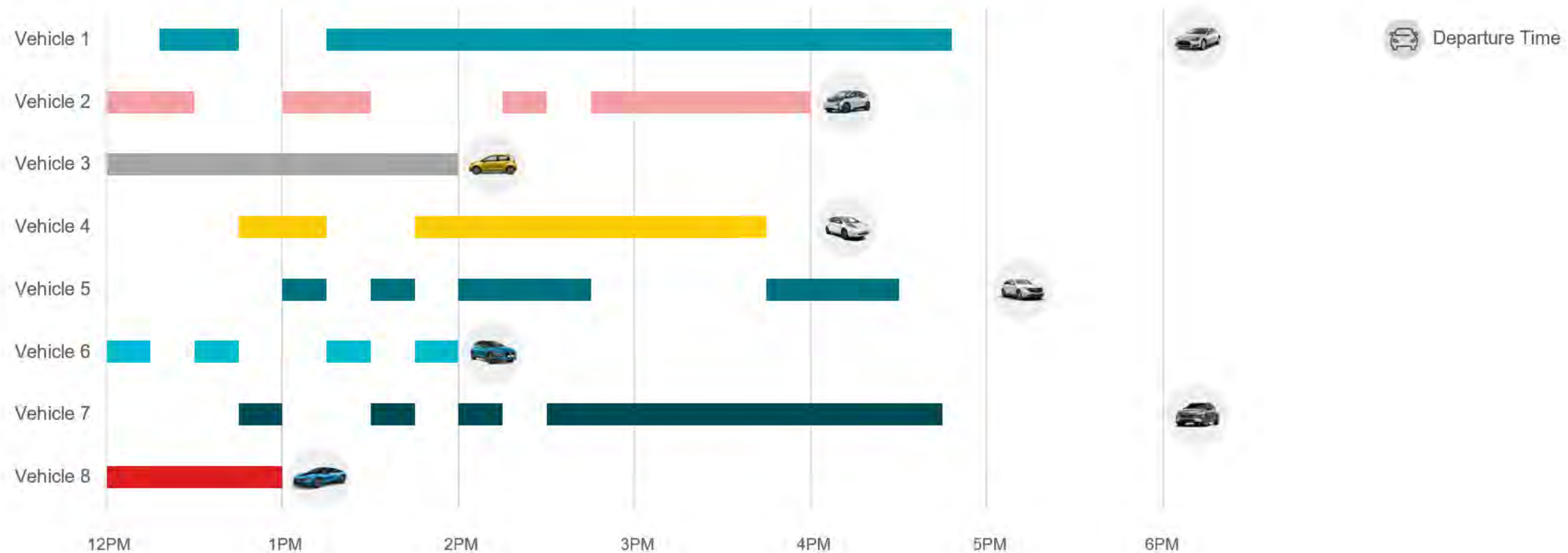
Unmanaged Fleet Charging



Optimized Fleet Smart Charging

Vehicles don't start charging as soon as they are connected. The load limit and the schedule will determine when the vehicle is to be charged.

Optimized Fleet Smart Charging Schedule

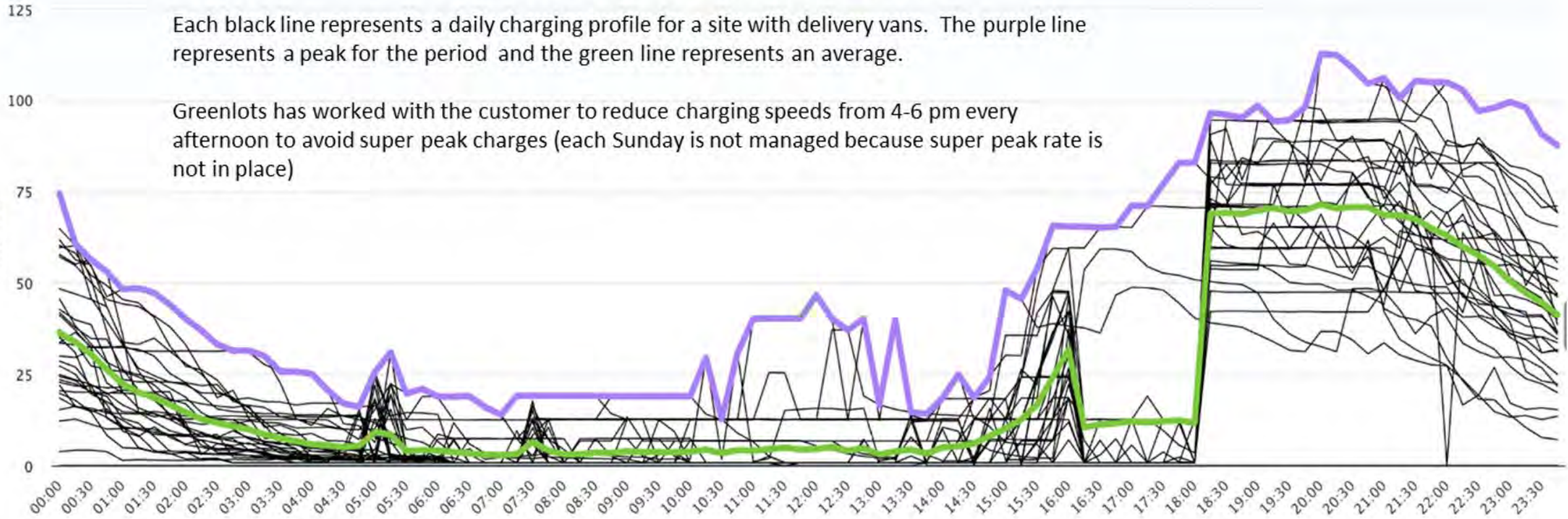


Case Study

Minimizing charging speeds when utility rates are higher – or to avoid peak rates – while ensuring that fleet vehicles can meet their delivery obligations

2021-02-10 13:35:00 - 2021-03-12 13:34:00

— Daily Load — Average Load — Peak Load



Cloud-to-vehicle lab testing drives in-field uptime

Where software and hardware come together to charge the future

- Cloud-to-vehicle testing across use cases minimizes in field risks
- Simulation of customer specific use cases including micro-grids enables fine tuning of field designs
- Nothing goes out the door without end-to-end validation



+



+



Volvo LIGHTS: Innovative charging solutions



The first heavy-duty fleet charging project to demonstrate the viability of **Class 8 battery electric trucks** and equipment

3 150 kW DC Fast
Chargers across three
trucking facilities

6 50 kW DC Fast
Chargers across three
trucking facilities

15 Level 2
stations for light-duty
vehicles

50 Electric forklift
chargers for in-
warehouse operations

Lessons Learned:

- Many stakeholders: site host fleet, utility, auto OEM (Volvo), hardware manufacturer – integrated PM approach is critical
- Although project is subsidized, it's important to start to analyze path to cost parity with diesel

Thank you!

Scott Fisher

Interim Chief Commercial Officer / Vice
President- Fleets & OEMs



greenlots
A Member of the Shell Group



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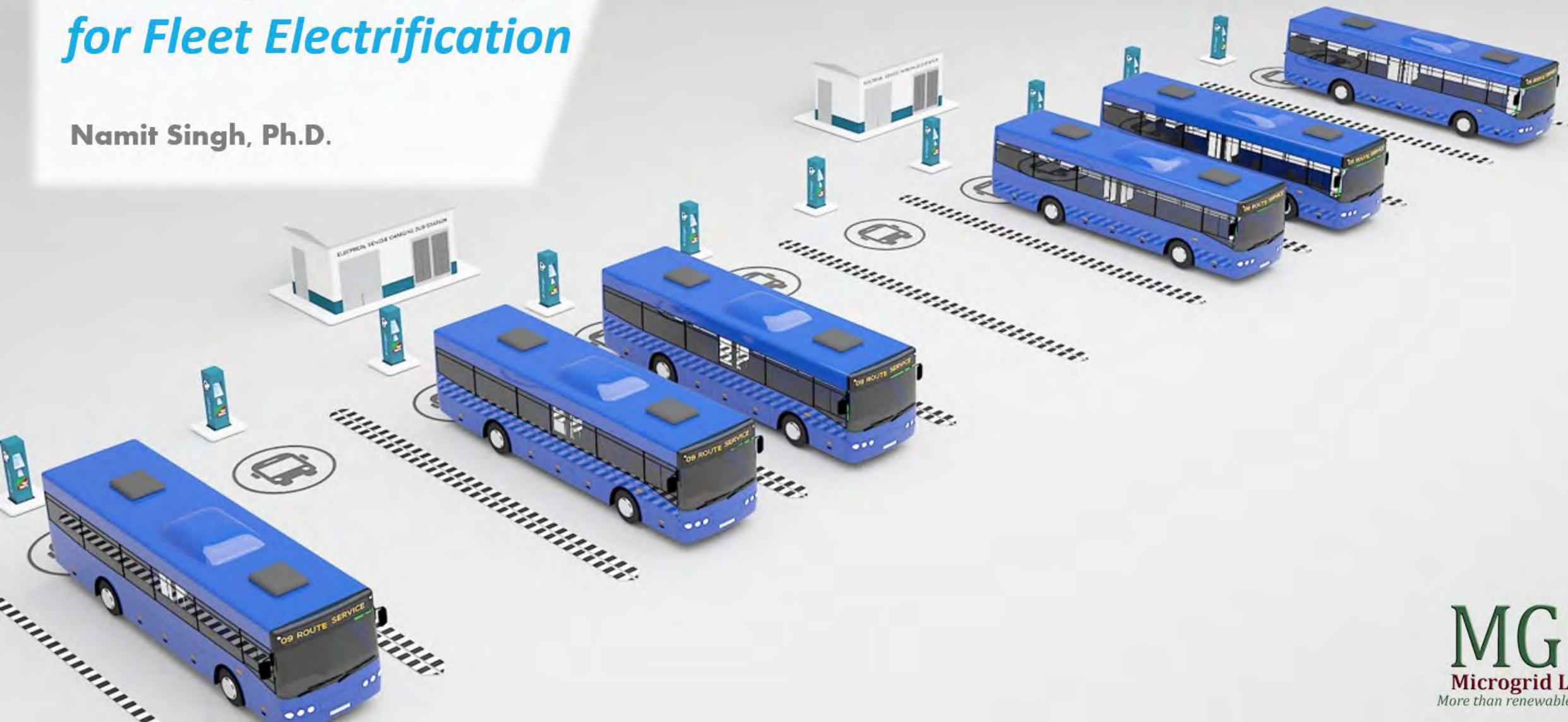
Christy Lewis

*Director of Analysis
WattTime*



Microgrid Planning for Fleet Electrification

Namit Singh, Ph.D.



FLEET ELECTRIFICATION: COMPONENTS AND INTERDEPENDENCE

ELECTRIC
VEHICLE



CHARGING
INFRASTRUCTURE



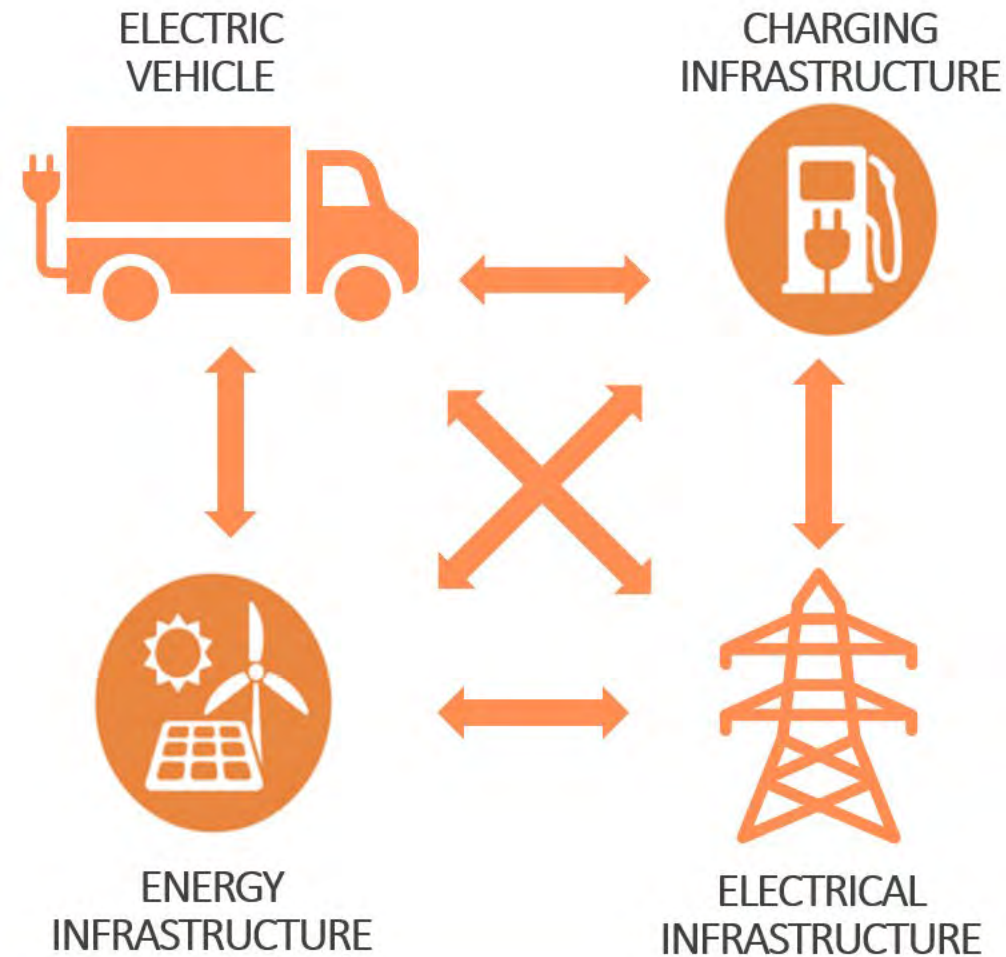
ENERGY
INFRASTRUCTURE



ELECTRICAL
INFRASTRUCTURE



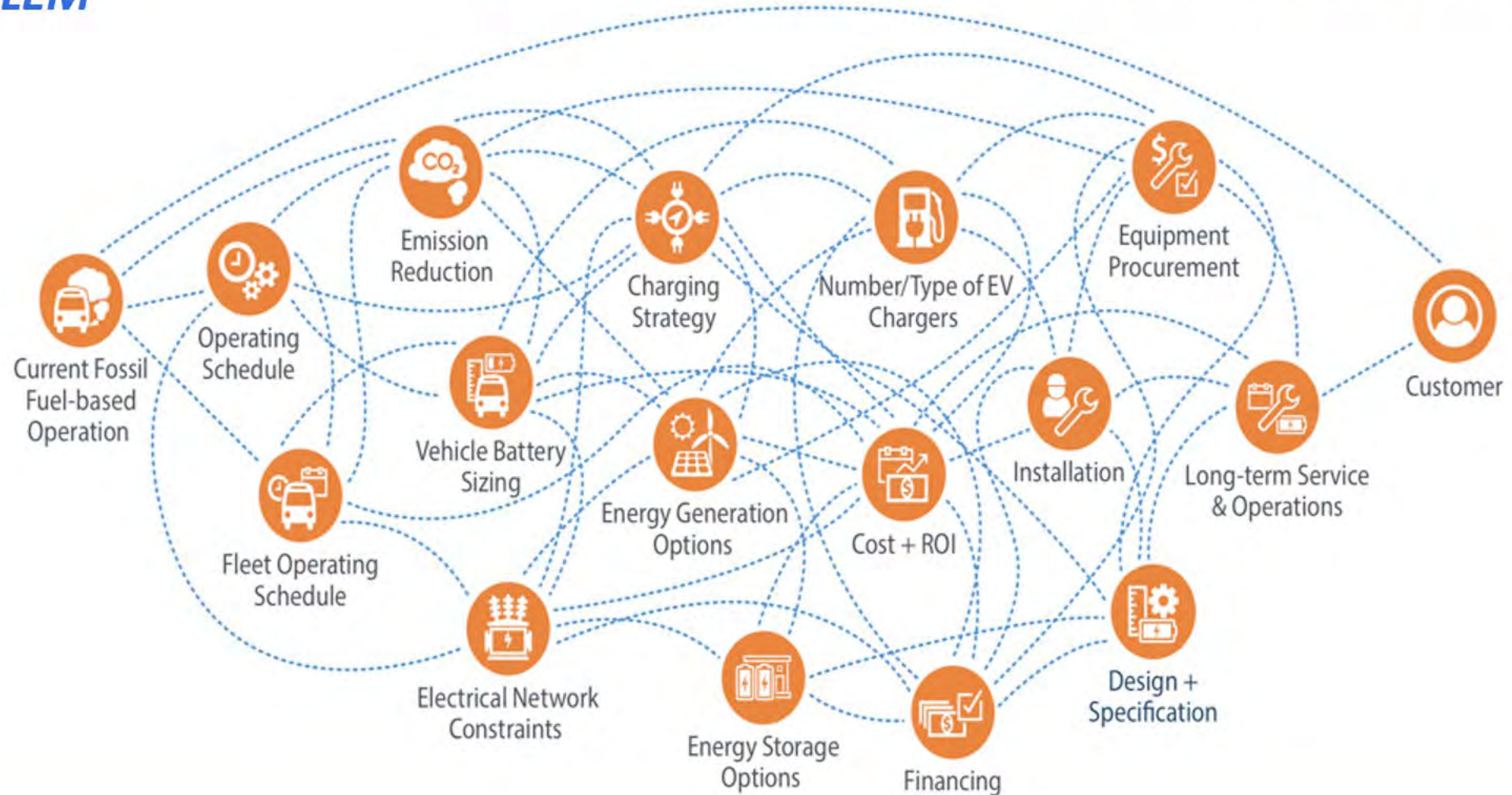
FLEET ELECTRIFICATION: COMPONENTS AND INTERDEPENDENCE



FLEET ELECTRIFICATION: COMPLEX AND EXPENSIVE

PROBLEM

NO PUBLICLY AVAILABLE SOFTWARE TOOL FOR DETAILED ANALYSIS



UTILITY TARIFF STRUCTURE

EXAMPLE 1 TIME OF USE ELECTRICITY RATES



- ▶ 8.5 ¢/kWh
- ▶ 11.9 ¢/kWh
- ▶ 17.6 ¢/kWh



WHEN YOU BUY?

At 8am \$3.0/Gal
At 1pm \$4.5/Gal
At 6pm \$6.5/Gal

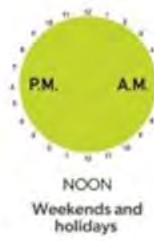
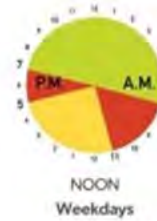


UTILITY TARIFF STRUCTURE

EXAMPLE 1 TIME OF USE ELECTRICITY RATES



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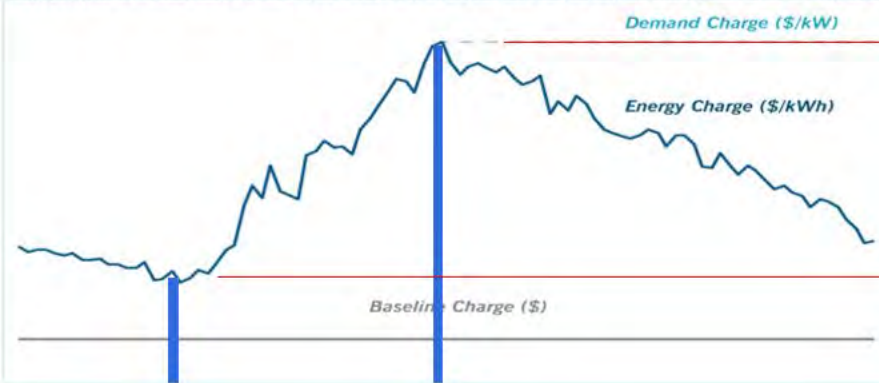


WHEN YOU BUY?

At 8am \$3.0/Gal
At 1pm \$4.5/Gal
At 6pm \$6.5/Gal



EXAMPLE 2 DEMAND CHARGE ELECTRICITY RATES



100kW
\$2000

25kW
\$500

HOW MUCH YOU BUY?

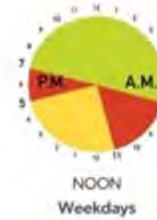


UTILITY TARIFF STRUCTURE

EXAMPLE 1 TIME OF USE ELECTRICITY RATES



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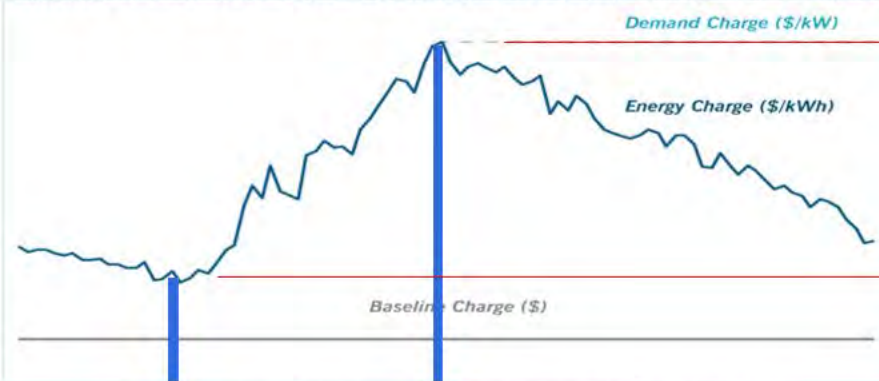


WHEN YOU BUY?

At 8am \$3.0/Gal
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EXAMPLE 2 DEMAND CHARGE ELECTRICITY RATES



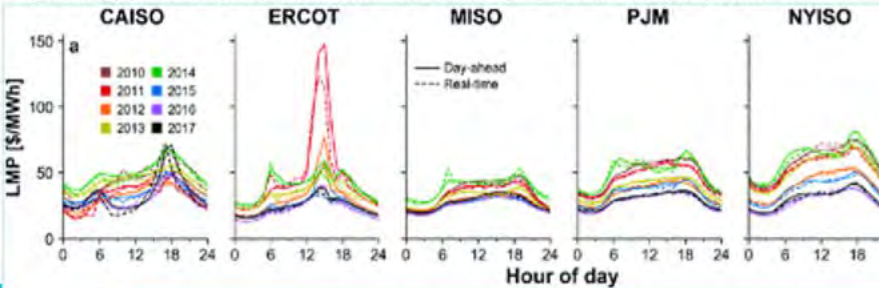
100kW
\$2000

25kW
\$500

HOW MUCH YOU BUY?



EXAMPLE 3 DAY AHEAD / REAL TIME LMP



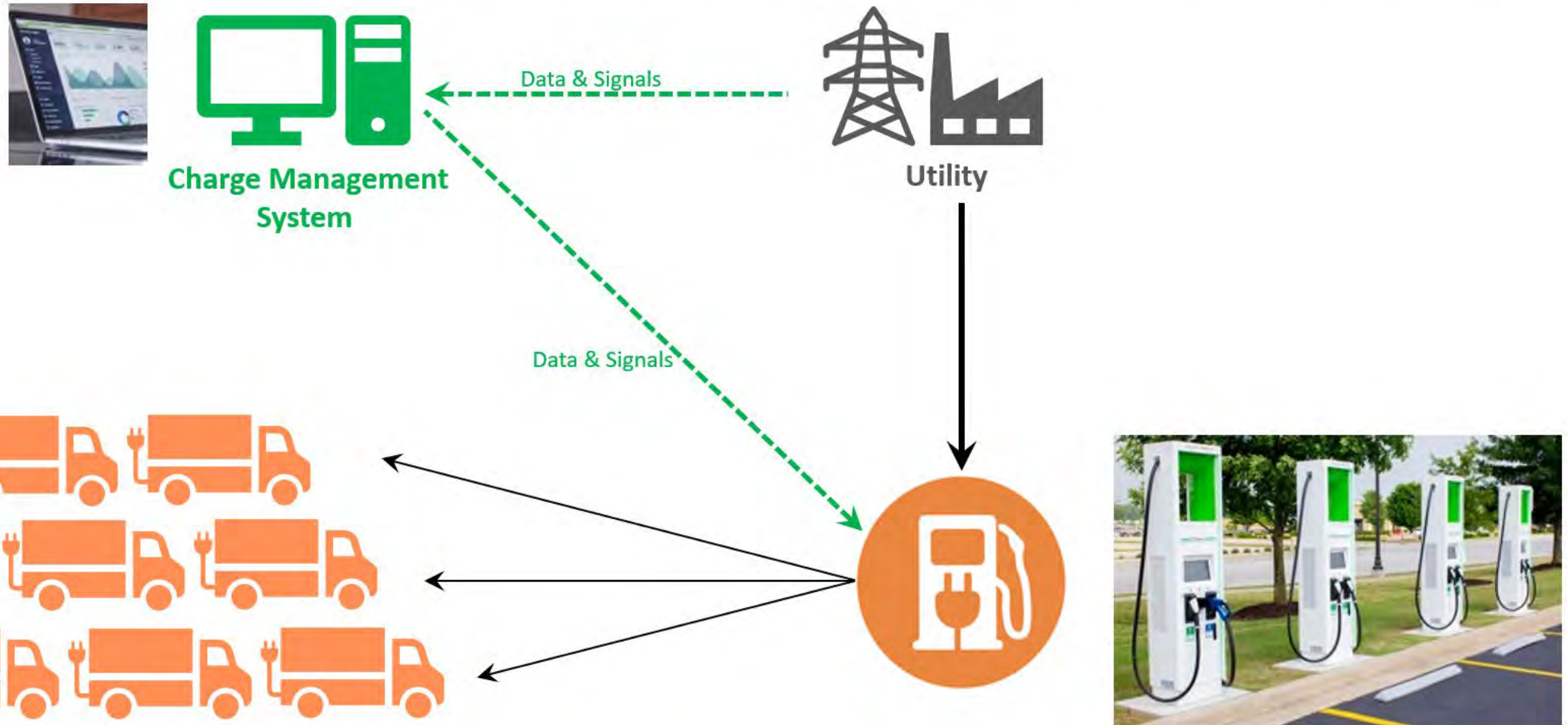
REAL TIME?



~3000 UTILITIES IN US

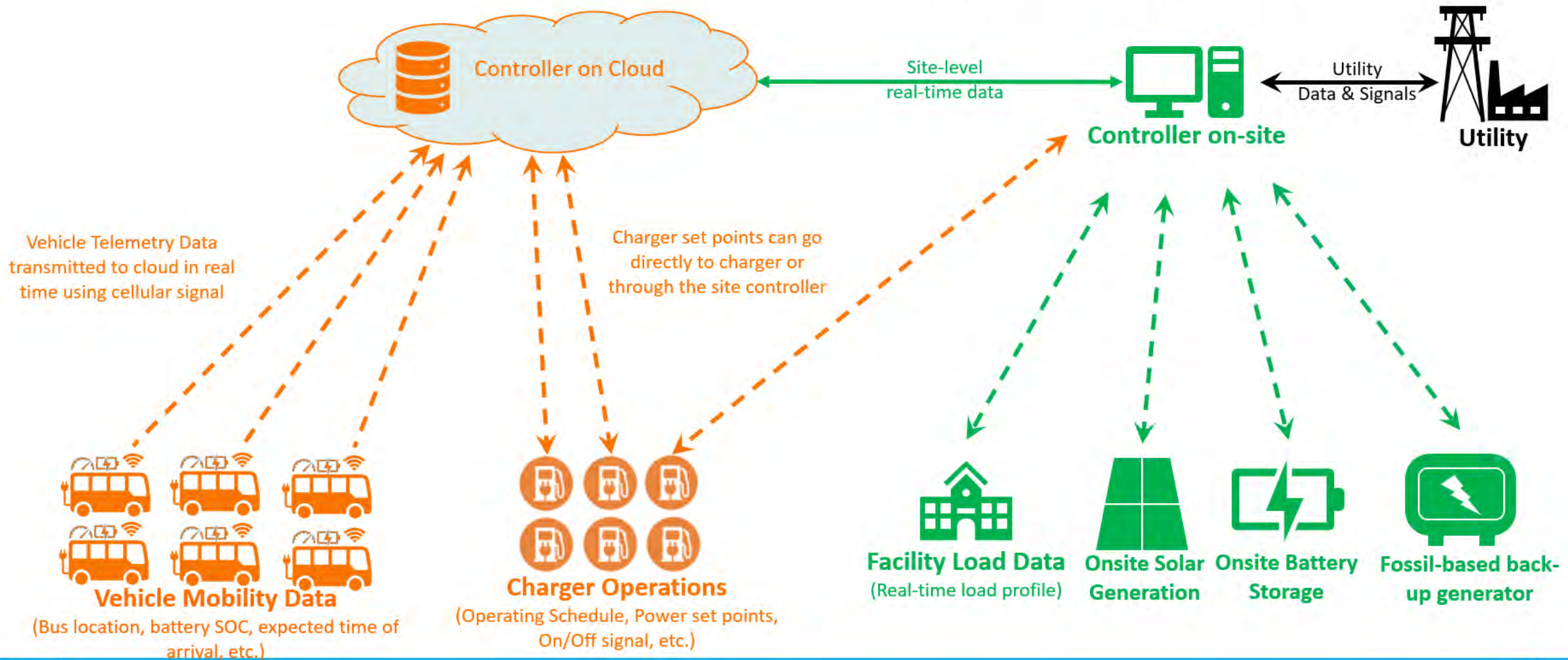
SIMPLE CHARGE MANAGEMENT SYSTEM

MOSTLY THESE ARE FOCUSED ON MONITORING AND SIMPLE RULE BASED CONTROLS



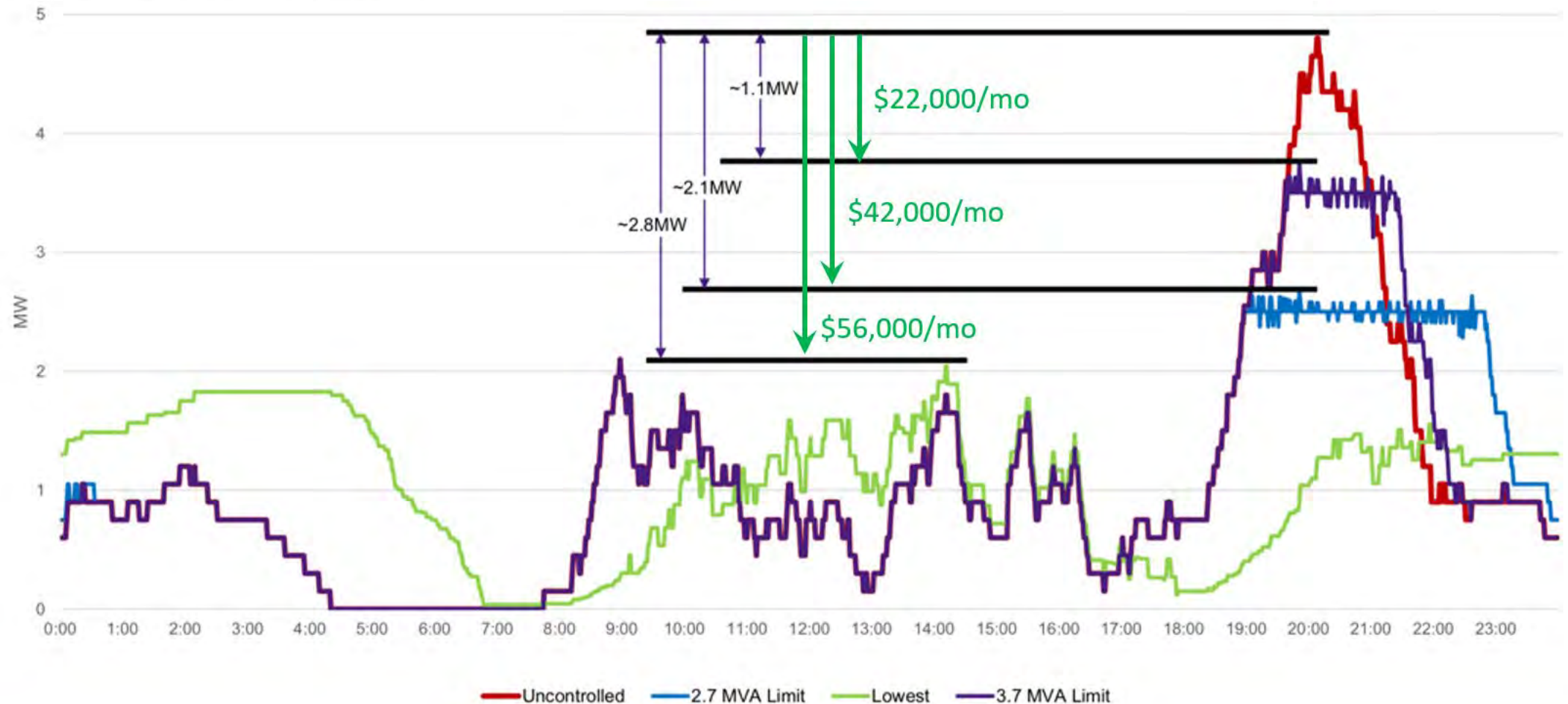
SYSTEM LEVEL DESIGN AND OPTIMIZATION

REAL TIME OPTIMIZATION AND CONTROLS



CONTROLLED CHARGING

Peak load reduction scenarios



KEY TAKE AWAY:

- FOR FLEET ELECTRIFICATION, YOU ARE RESPONSIBLE FOR THE WHOLE SYSTEM.***
- SYSTEM LEVEL DESIGN SHOULD BE LOOKED AT ON DAY ONE AND SHOULD NOT BE AN AFTER THOUGHT.***



Thank You!!

MGL
Microgrid Labs
More than renewable energy

Namit Singh, Ph.D.

Boulder, CO

Namit@microgridlabs.com

18th May, 2021

NACFE Run On Less-Electric

Today's Speakers:



Levi Lomeland

*Sr. Account Executive in charge
of West Coast Business
Development
Electriphi*



Scott Fisher

*Vice President of Fleets & OEMs
Greenlots*



Namit Singh, Ph.D.

*Chief Strategy Officer &
CoFounder
Microgrid Labs*



Pam MacDougall

*Senior Manager of Grid
Modernization
Environmental Defense Fund
(EDF)*



Christy Lewis

*Director of Analysis
WattTime*



NORTH AMERICAN COUNCIL FOR FREIGHT EFFICIENCY



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Heavy Duty Electrification: A Real-World Study of Class 8 Fleets

Pamela MacDougall

Grid Modernization Engineering and Strategy



Goal of Study



- *Fleet needs:* Determine what infrastructure is needed to accommodate fleet electrification or if it is possible.
- *Total Cost of Infrastructure:* Evaluate the total cost and net present value of various charging infrastructure installments as well as impact of existing rebates, programs and DERs on TCO.
- *Cost of Charging:* Analyze annual cost of charging under various electricity rates, and the impact of managed charging and DERs on charging costs.



Fleet	Annual VMT	Number of Trucks	Location
NFI	40,000	50	Southern California
Schneider	67,000	42	Central California



Key Takeaways



1. Existing and upcoming technology can meet most of the operational needs of Class 8 Trucks with on-site depot charging.
2. Managed (smart) charging and on-site distributed energy resources (DERs) like batteries and solar will be critical to making infrastructure costs affordable.
3. Charging infrastructure investments required for Class 8 fleets are significant and can vary dramatically.
4. Additional policies and programs that reduce the infrastructure costs required for fleet electrification will be essential to accelerate the transition of Class 8 trucks.

Fleet Electrification



Fleet	Schneider	NFI	NFI
Scenario Name	Baseline	Current Technology	Advanced Technology
DCFC Power Level (kW)	150	150	800
Truck Battery Capacity (kWh)	1,000	500	1,000
% of Successful Trips	88%	71%	93%
Maximum Number of Chargers In Use	25	40	40

Fleets CAN Electrify and Meet Operational Needs

	Diesel	Electricity	Savings
Schneider Annual Fuel Cost	\$1,536,656	\$981,843	\$554,813
NFI Annual Fuel Cost	\$1,387,735	\$639,424	\$748,311

Electric Trucks CAN have Annual Fuel Cost Savings!

Impact of Smart Charging on Costs



Unmanaged Charging

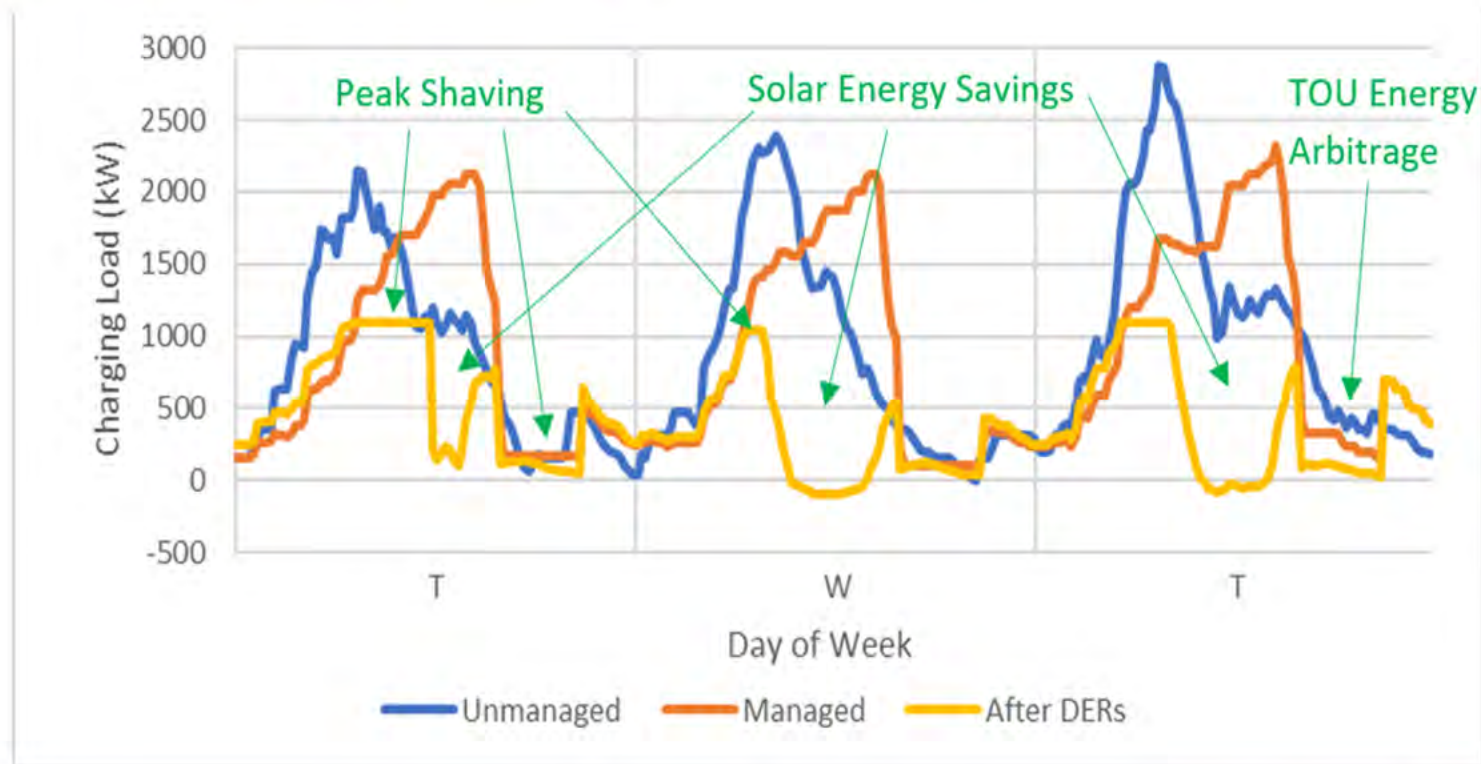
Energy	Demand	Fixed	Total Bill	Rate Type
\$636,364	\$0	\$3,061	\$639,424	Demand Holiday
\$525,505	\$437,338	\$3,061	\$965,904	Demand Holiday*
\$350,796	\$883,764	\$3,061	\$1,237,621	TOU
\$725,817	\$70,964	\$0	\$796,781	Demand Subscription

Managed Charging

Energy	Demand	Fixed	Total Bill	Rate Type
\$578,549	\$0	\$3,061	\$581,609	Demand Holiday
\$470,269	\$400,565	\$3,061	\$873,895	Demand Holiday*
\$342,364	\$760,266	\$3,061	\$1,105,691	TOU
\$685,175	\$64,997	\$0	\$750,173	Demand Subscription

Smart Charging Saves Fleets Money.

Solar and Storage Benefits for 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



Pamela MacDougall, PhD
pmacdougall@edf.org



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(EDF)*



Christy Lewis

*Director of Analysis
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Run On Less – Electric Truck Bootcamp

May 18, 2021



WattTime

“Giving people the power to choose cleaner electricity”

Who we are

- High-tech nonprofit dedicated to accelerating the development & spread of new sustainability techniques
- Built by 200+ volunteers from Google, MIT, Climate Corp, DOE, and more
- Joined forces with Rocky Mountain Institute in 2017

What we do

- Obsessed with understanding grid emissions at a granular level and building tools to help others use that information to maximize impact and advance goals
- Effectively utilize granular emissions data (5-minute intervals) in over 100 U.S. grid regions with continued international expansion

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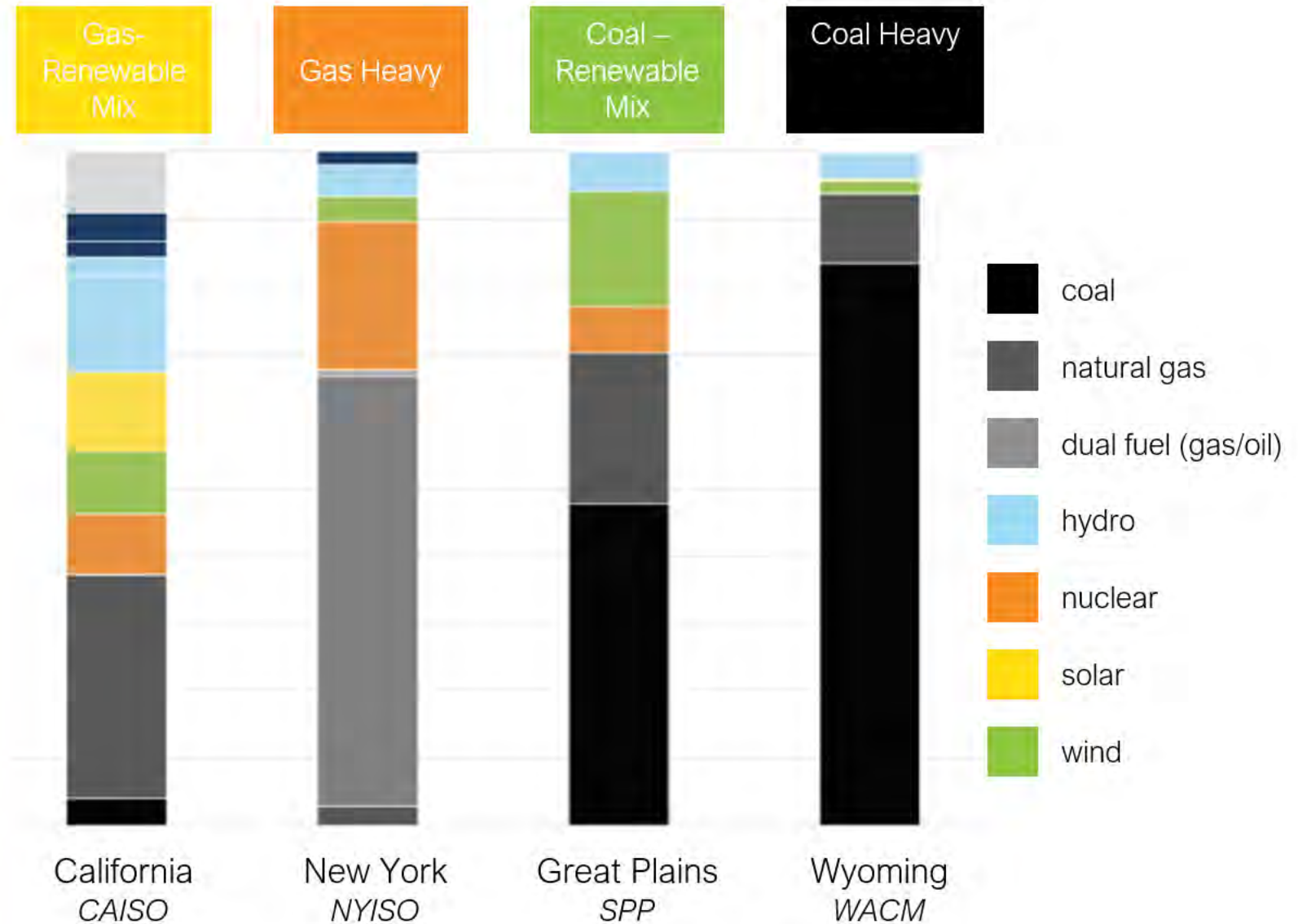
ENERGY INSTITUTE AT HAAS

Union of
Concerned
Scientists

eCHOING
GREEN

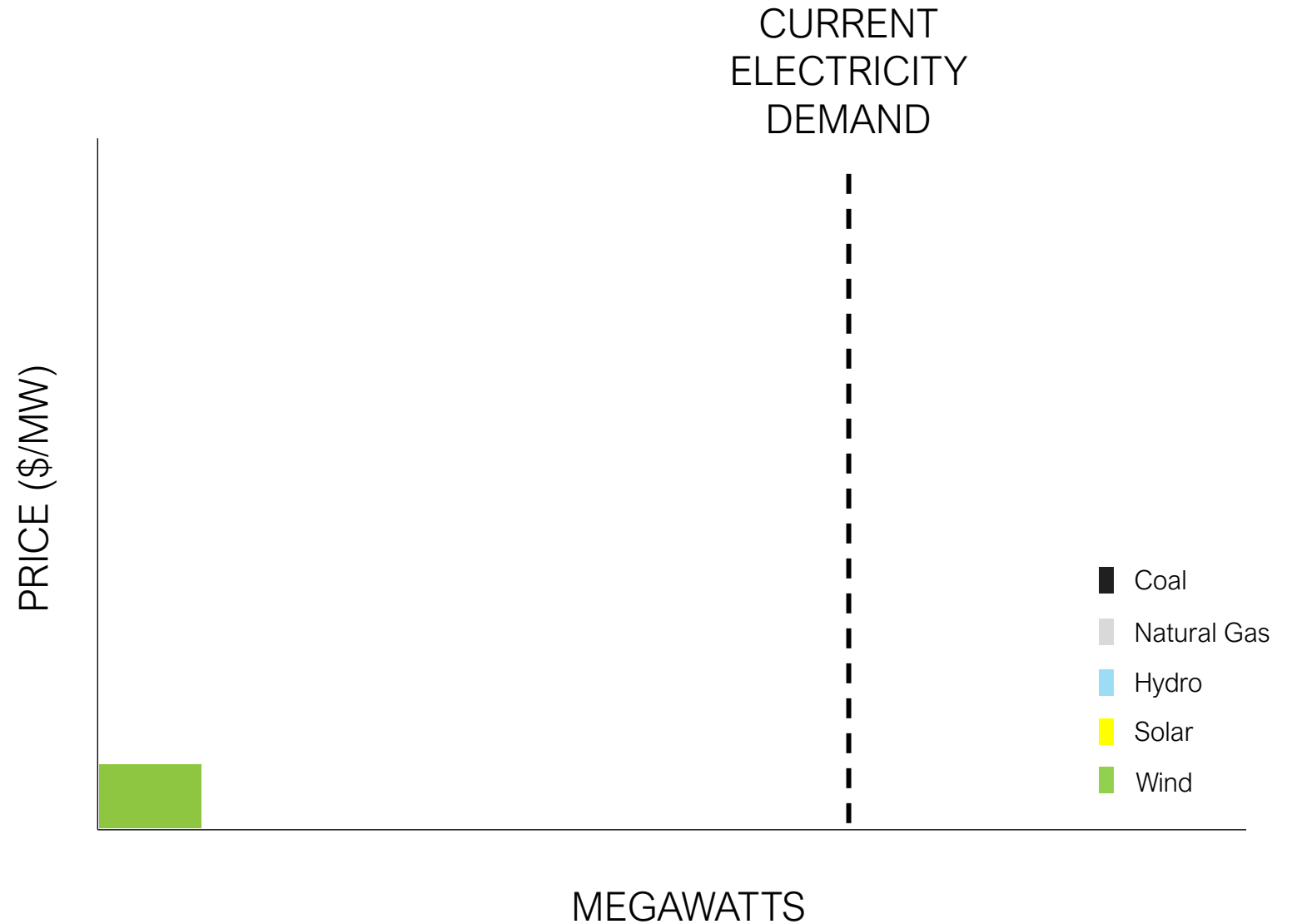
Electricity Sources

The electricity that charges your electric truck comes from a variety of sources.



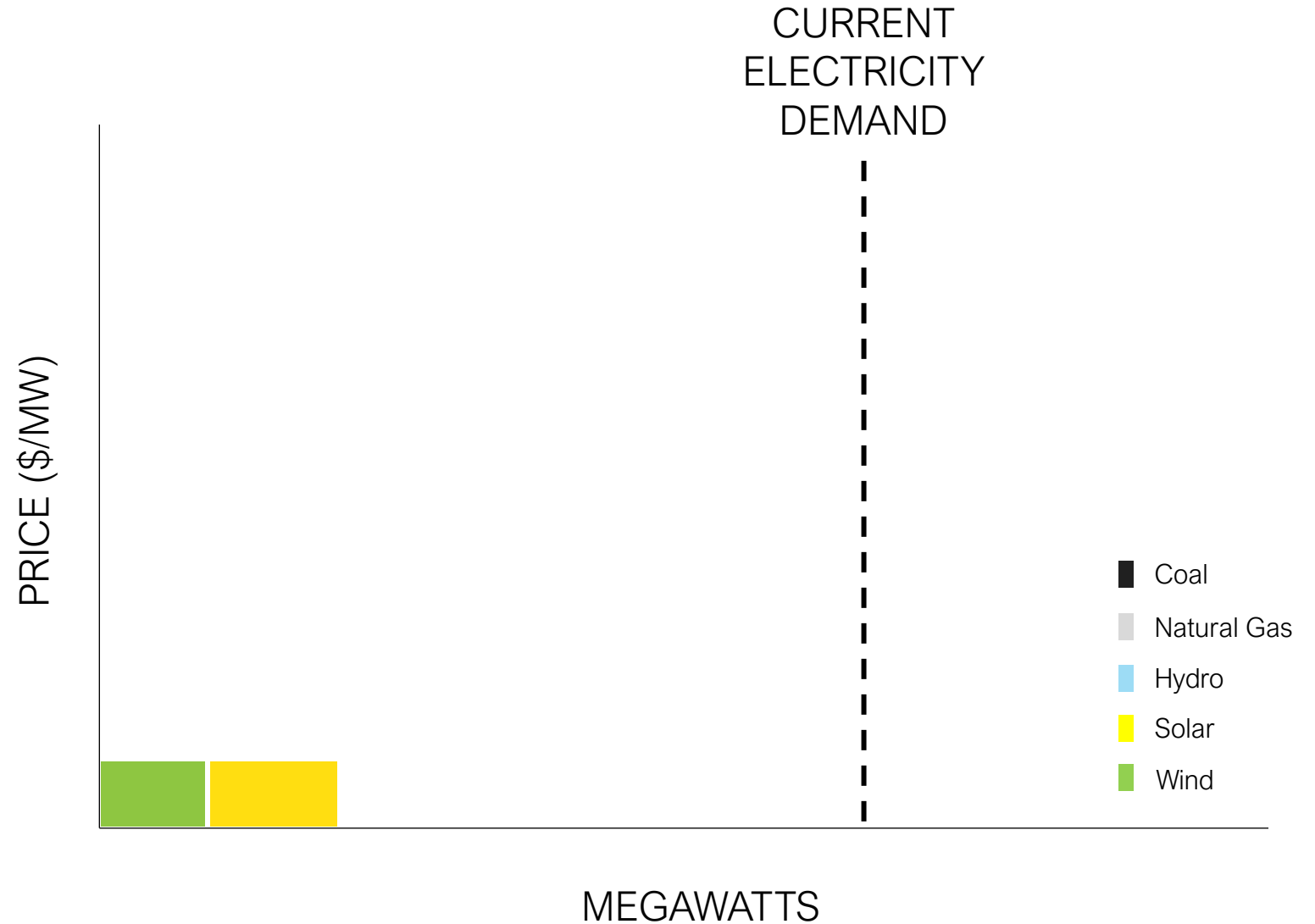
Marginal Emissions

The grid operators dispatch each power plant in order of cost, until reaching the quantity of power needed to serve current demand.



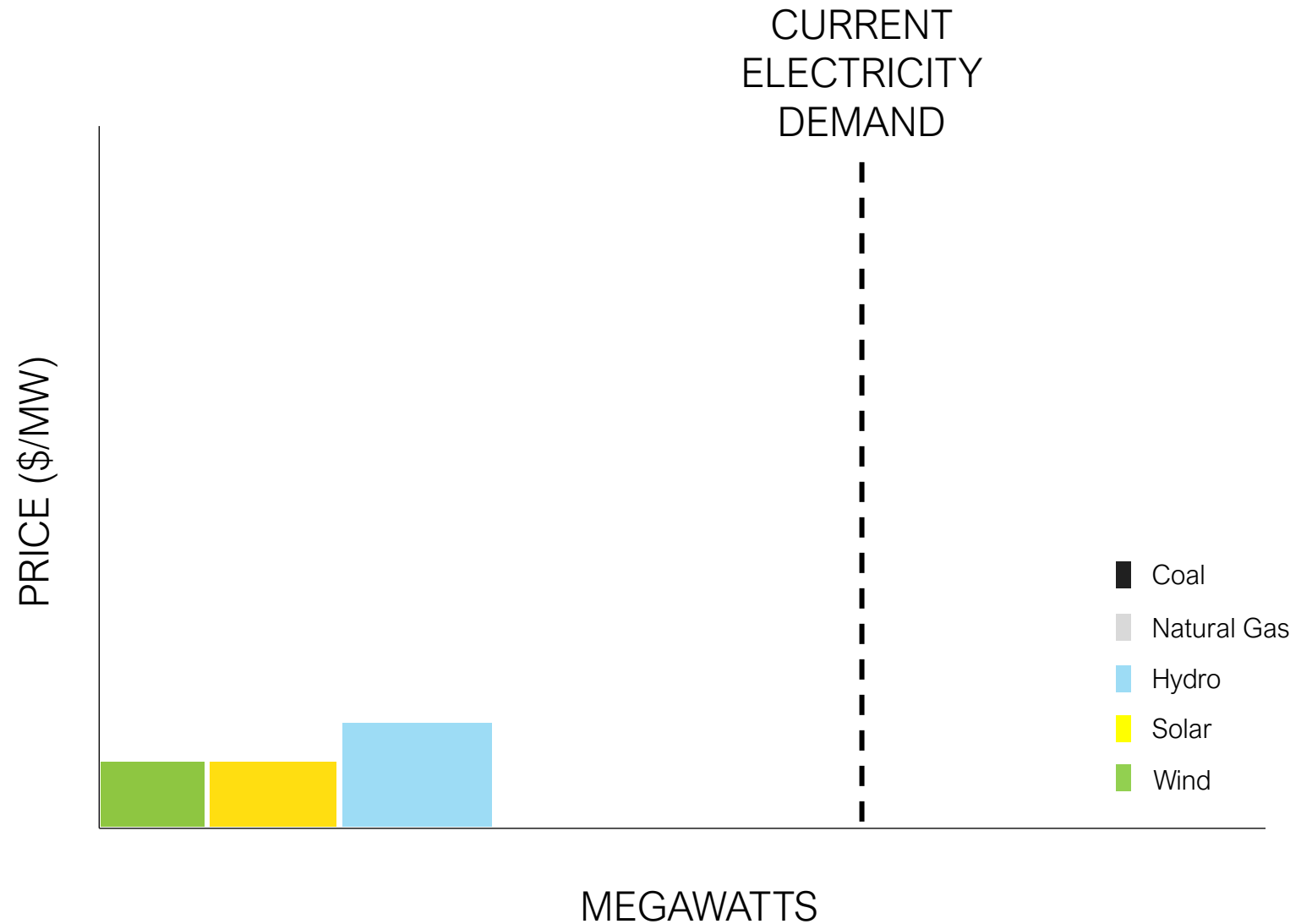
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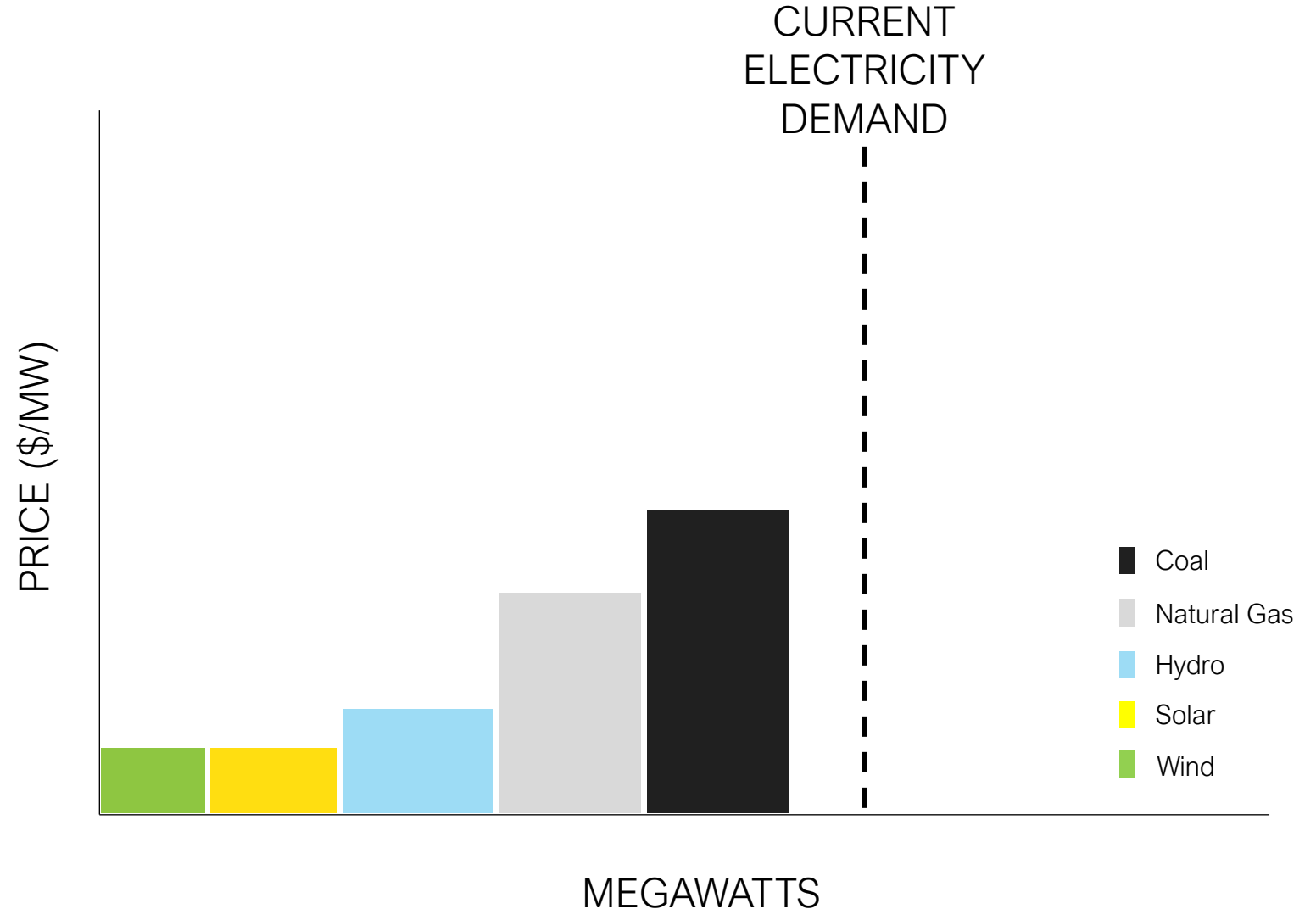
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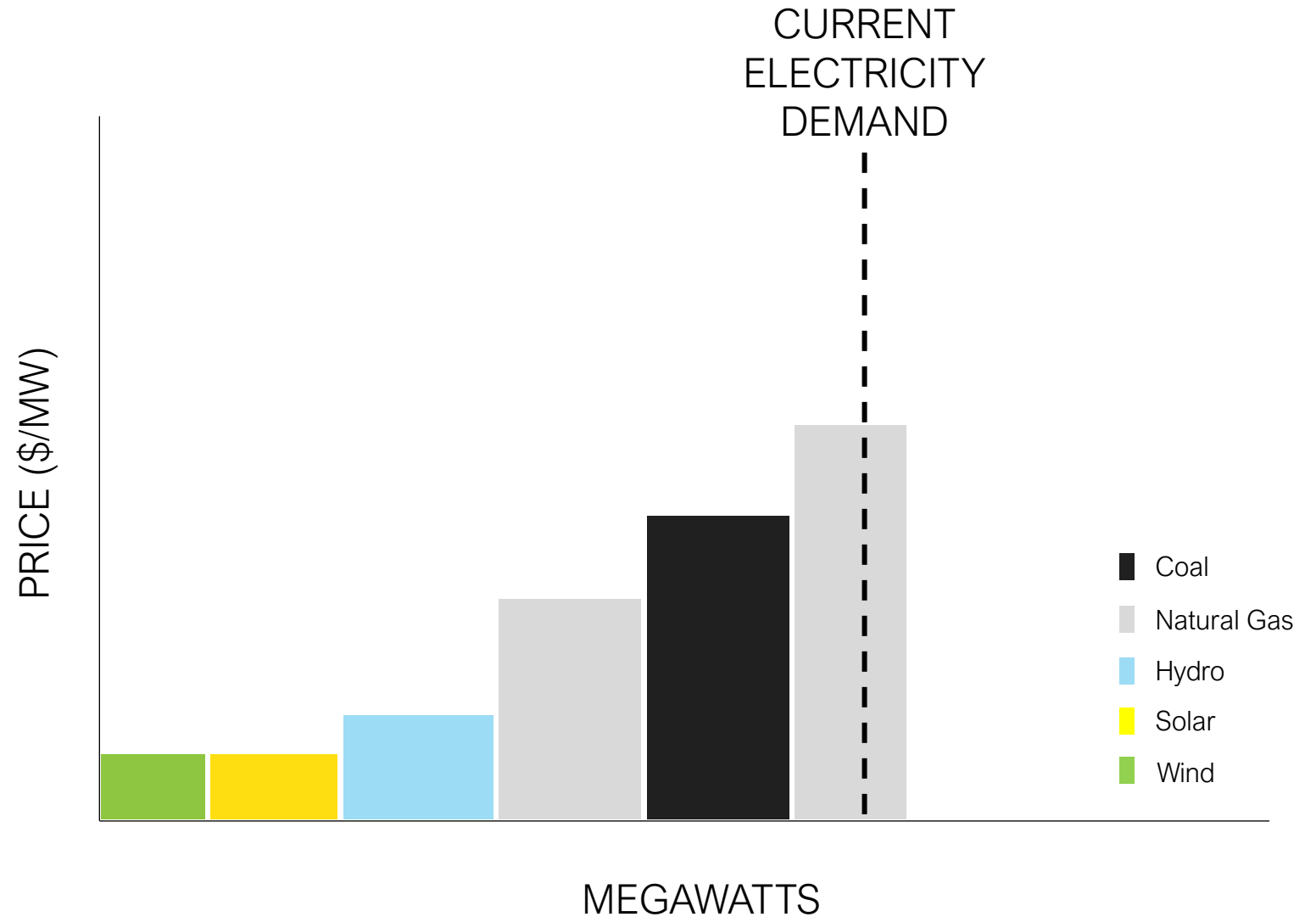
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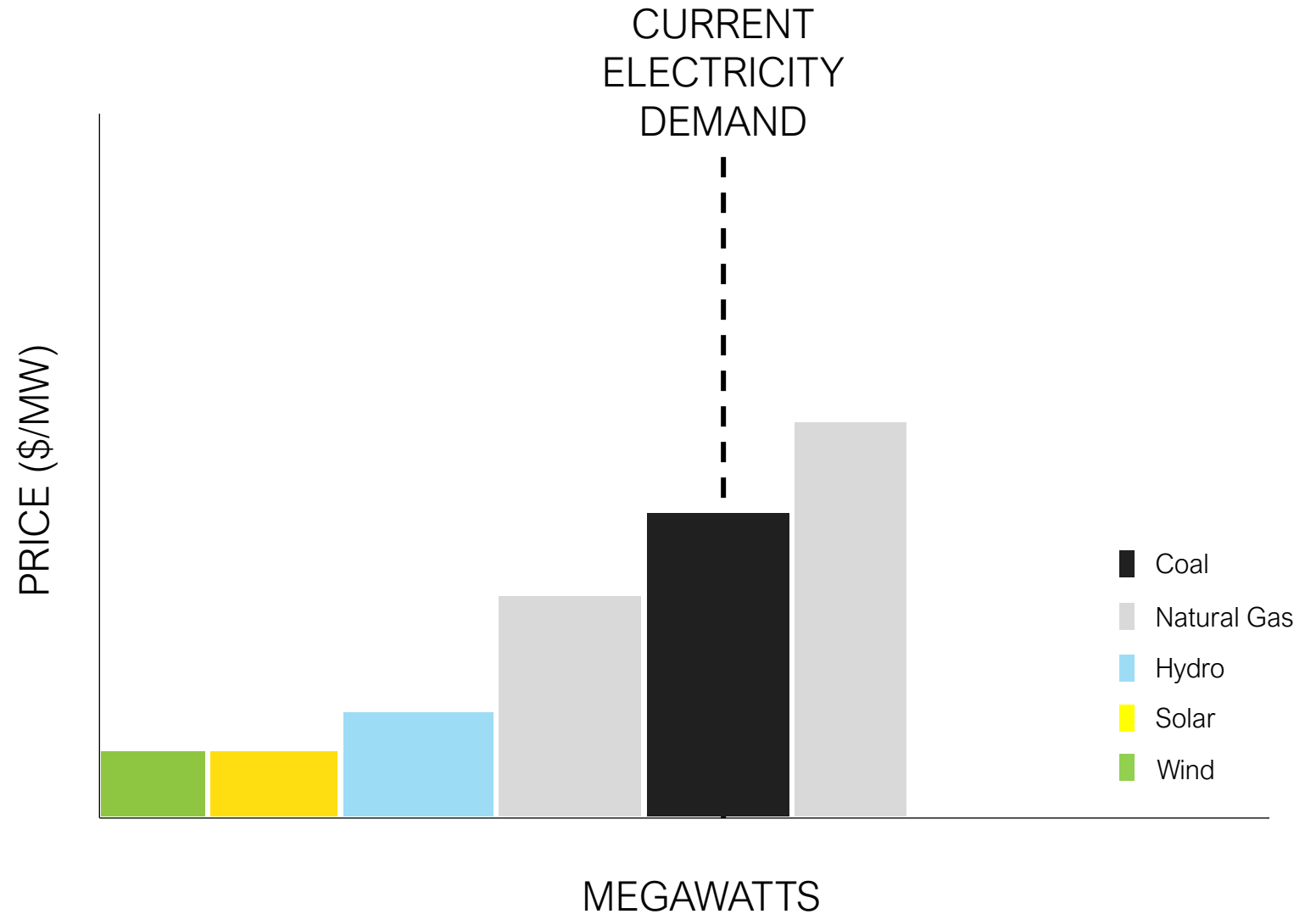
Marginal Emissions

The last unit is called the *marginal unit*, and the emissions caused by increase demand at that time are called *marginal emissions*.



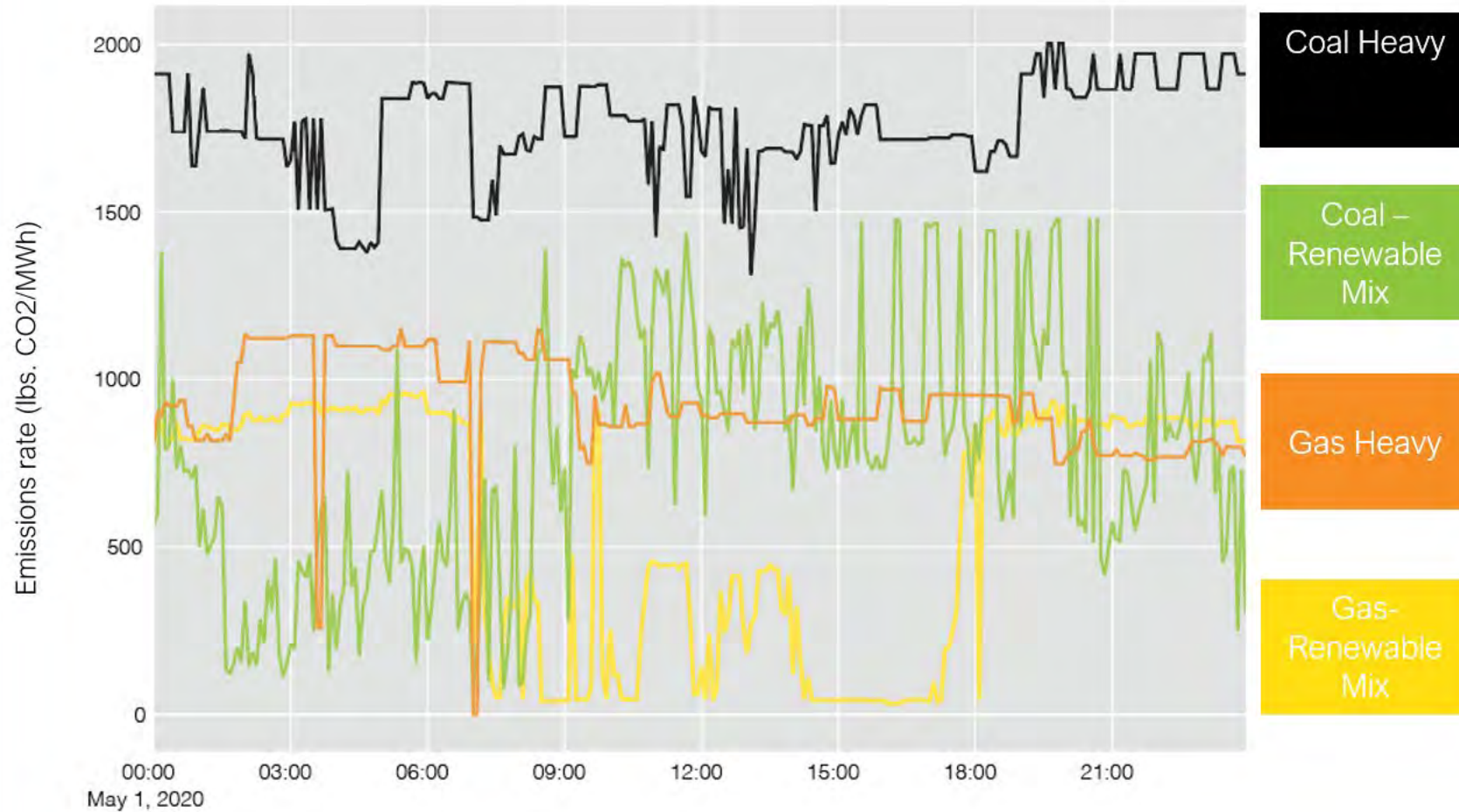
Marginal Emissions

The last unit is called the *marginal unit*, and the emissions caused by increase demand at that time are called *marginal emissions*.



Electricity Emissions Profiles

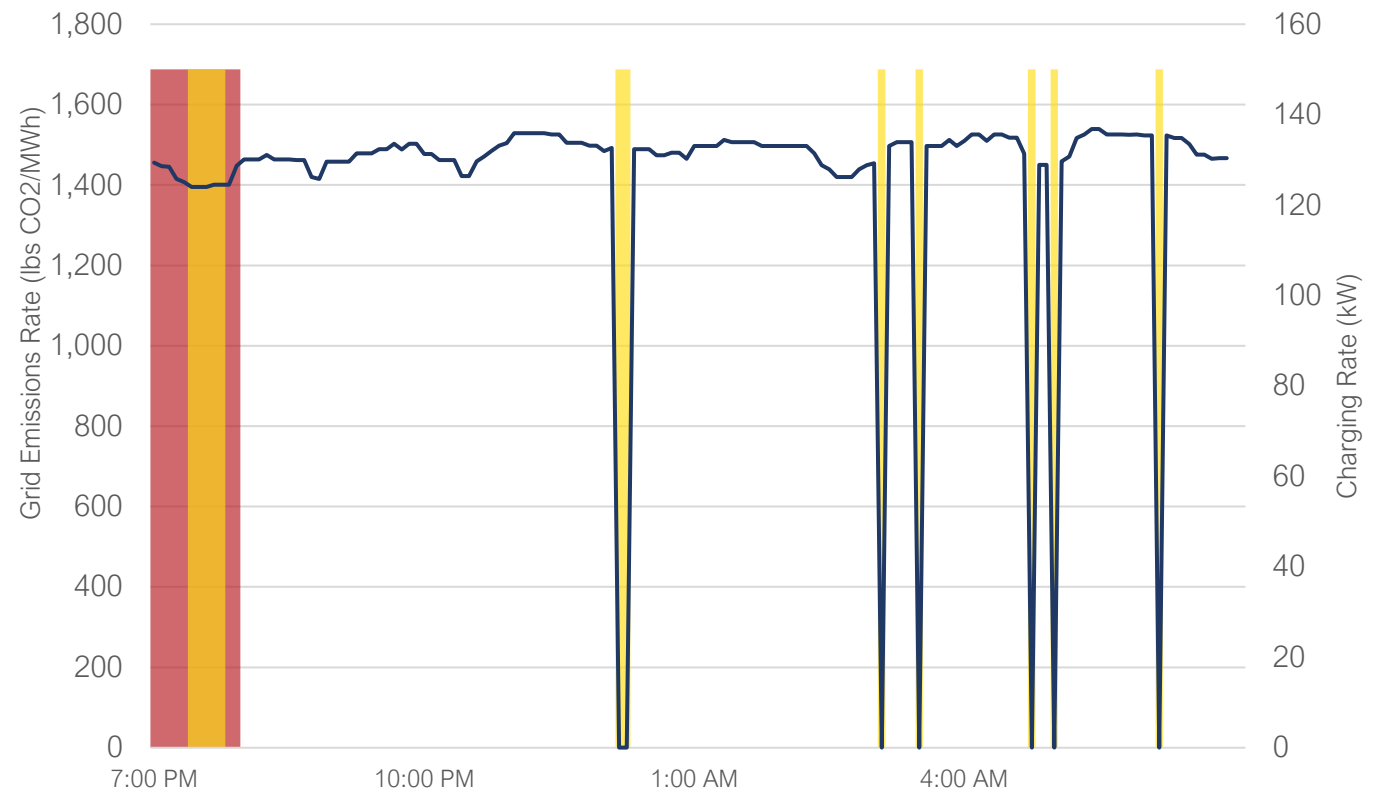
Marginal emissions can vary dramatically throughout the day, and are heavily affected by where you are charging.



Emissions Optimized Charging

Simulation details:

- 500 miles of charge
- Overnight charging:
7pm-7am
- 150 kW charger



Baseline Charging CO ₂ (tons)	27
--	----

Optimal Charging CO ₂ (tons)	12
---	----

% Reduction of CO ₂	55%
--------------------------------	-----

Thank You

Christy Lewis

Director of Product and Analysis

Christy@WattTime.org



Q&A:



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Electric Truck Expert badge, please
visit: www.RunOnLess.com



Our next training is **June 1** on Working with Your Utility

